# CLINICO-RADIOLOGICAL PROFILE OF SPINE INJURY AT DAYANAND MEDICAL COLLEGE AND HOSPITAL

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I hereby declare that the thesis entitled **"CLINICO-RADIOLOGICAL PROFILE OF SPINE INJURY AT DAYANAND MEDICAL COLLEGE AND HOSPITAL"** submitted towards partial fulfillment of the requirements for the award of **MCh IN NEURO-SURGERY** degree to BFUHS is a compilation of original work carried out by me under the supervision of **Dr. Ashwani K. Chaudhary,** Professor & Head, Neuro-Surgery & **Dr. Hanish Bansal,** Associate Professor, Department of Neuro-Surgery. No part of this thesis has formed the basis for the award of any degree previously.

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*Dedicated*

*to*

*my Family*

*&*

*Teachers*

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**Dr. Swarjith Nimmakayala**

# LIST OF ABBREVIATIONS

| | |
|---|---|
| ACDF | ANTERIOR CERVICAL DISCECTOMY AND FUSION |
| ASIA | AMERICAN SPINAL INJURY ASSOCIATION |
| ACCF | ANTERIOR CERVICAL CORPECTOMY AND FUSION |
| BSB | BLOOD SPINAL BARRIER |
| DVT | DEEP VENOUS THROMBOSIS |
| EDH | EPIDURAL HEMATOMA |
| GCS | GLASGOW COMA SCALE |
| HMV | HEAVY MOTOR VEHICLE |
| LMV | LIGHT MOTOR VEHICLE |
| MVA | MOTOR VEHICLE ACCIDENT |
| MRS | MODIFIED RANKIN SCALE |
| MRI | MAGNETIC RESONANCE IMAGING |
| NCCT | NON CONTRAST COMPUTED TOMOGRAPHY |
| NH | NATIONAL HIGHWAY |
| NLI | NEUROLOGICAL LEVEL OF INJURY |
| RSA | ROAD SIDE ACCIDENT |
| RTA | ROAD TRAFFIC ACCIDENT |
| SH | STATE HIGHWAY |
| SCI | SPINAL CORD INJURY |
| TSCI | TRAUMATIC SPINAL CORD INJURY |

# ABSTRACT

**Background:** Traumatic spinal injuries comprise of either column fractures or spinal cord injuries or both. Spinal injury is one of the most devastating injuries having a great impact on patients, their families, and society. It may lead to serious disability when the spinal cord is involved, with long-term medical complications and psychiatric illness. The major cause of injury in the developed world is due to motor vehicle accidents. Fall from height is the most common cause of spine injury in Southern Asia.

**Objective:** To determine the clinico-radiological profile of spinal injuries in our institute and identify prognostic factors and determine outcomes.

**Methods:** The patients presented to Dayanand Medical College and Hospital, Ludhiana, Emergency with history of trauma were taken into the study group. The study period was extended from September 2021 to August 2022.

**Results:** Spine trauma was more common in males than females with male to female ratio of 3.7:1. The range of age of spine trauma (18-87 years) with mean age being 44.5 years. Majority of spine injury was seen in students (32.5%), aged < 30 years. More commonly involved is the cervical spine leading to quadriplegia and complications.

**Conclusions:** Most of the spine injuries occurred during winter season which accounted for 44.1%, due to low visibility and high risk of road traffic accidents. The most common cause of spine injury was RSA (65.1%). Most common ASIA scale at the time of admission was GRADE A (58.1%). Most common level of spine injury was in cervical region (78.1%) followed by thoracic region (9.3%). Most common MRI finding in our study was cord contusion (46.5%). who were surgically managed, about 61.1% of injuries were seen in cervical region and they underwent anterior cervical discectomy and fusion (ACDF/ACCF) and those with dorsal and lumbar spine injury underwent decompression and transpedicle screw fixation.



**Key words:** spine injury, quadriplegia, neurological deficit, fixation, mortality and morbidity.

# TABLE OF CONTENTS


| S.NO. | TOPIC | PAGES |
|---|---|---|
| I | INTRODUCTION | 1-15 |
| II | AIMS AND OBJECTIVES | 16 |
| III | REVIEW OF LITERATURE | 17-26 |
| IV | MATERIALS AND METHODS | 27-28 |
| V | OBSERVATIONS AND RESULTS | 29-51 |
| VI | DISCUSSION | 52-58 |
| VII | SUMMARY AND CONCLUSIONS | 59-61 |
| VIII | BIBLIOGRAPHY | 62-69 |

APPENDICES–I

- PROFORMA
- MASTER CHART

APPENDICES–II

- APPROVAL LETTER OF THESIS PLAN
- THESIS PLAN

# LIST OF TABLES


| TABLE NO. | TITLE | PAGE NO. |
|---|---|---|
| 1 | Gender distribution | 29 |
| 2 | Age distribution | 30 |
| 3 | Occupation distribution | 31 |
| 4 | Mode of injury | 32 |
| 5 | Time of injury | 33 |
| 6 | Seasonal Incidence Of Spine Injuries | 34 |
| 7 | Type of vehicle involved in RSA | 35 |
| 8 | Mode of injury due to fall | 36 |
| 9 | GCS at admission | 37 |
| 10 | ASIA score at the time of admission | 38 |
| 11 | Level of spine injury | 39 |
| 12 | Level of fracture distribution | 40 |
| 13 | Type of spinal fracture | 41 |
| 14 | Listhesis with fracture | 42 |
| 15 | Neurological deficit | 43 |
| 16 | Associated injuries | 44 |
| 17 | MRI finding in spine injury | 45 |
| 18 | Associated medical conditions of spine injury patient | 46 |
| 19 | Management of spine injury | 47 |
| 20 | Conservative management of spine injury | 48 |
| 21 | Surgically managed level of spinal injury | 49 |
| 22 | Duration of hospital stay | 50 |
| 23 | MRS score on follow up | 51 |

# LIST OF FIGURES


| FIGURE NO. | TITLE | PAGE NO. |
|---|---|---|
| 1 | Pie diagram showing gender distribution | 29 |
| 2 | Bar diagram showing age distribution | 30 |
| 3 | Pie diagram showing occupation distribution | 31 |
| 4 | Pie diagram showing mode of injury | 32 |
| 5 | Bar diagram showing the time of injury | 33 |
| 6 | bar diagram showing seasonal distribution of spine injuries | 34 |
| 7 | Bar diagram showing the type of vehicle involved in RSA | 35 |
| 8 | Pie diagram showing mode of injury due to fall | 36 |
| 9 | Bar diagram showing GCS at admission | 37 |
| 10 | Pie diagram showing ASIA score at admission | 38 |
| 11 | Pie diagram showing the level of spine injury | 39 |
| 12 | Bar diagram showing level of fracture distribution | 40 |
| 13 | Bar diagram showing type of spinal fracture | 41 |
| 14 | Pie diagram showing listhesis with fracture | 42 |
| 15 | Bar diagram showing neurological deficit | 43 |
| 16 | Bar diagram showing the associated injuries | 44 |
| 17 | Bar diagram showing the MRI finding in spine injury | 45 |
| 18 | Bar diagram showing associated medical conditions | 46 |
| 19 | Pie diagram showing the management of spine injury | 47 |
| 20 | Bar diagram showing conservative management | 48 |
| 21 | Pie diagram showing the surgically managed level of spine injury | 49 |
| 22 | Bar diagram showing duration of hospital stay | 50 |
| 23 | Pie diagram showing MRS score on follow up | 51 |

# LIST OF PICTURES


| PIC NO. | TITLE |
|---|---|
| 1 | ASIA Scale |
| 2 | MR scale (modified Rankin scale) |
| 3 | Frankel Scale |
| 4A | X Ray showing fracture listhesis of C4/5 cervical spine |
| 4B | Sagittal section of NCCT cervical spine with C6/7 listhesis |
| 4C | Sagittal section showing MRI of cervical spine injury along with spinal cord injury |
| 4D | Transverse section of cervical spine with burst fracture at C6/7 level |
| 5A | X Ray showing post op ACDF of cervical spine injury |
| 5B | Sagittal section MRI cervical spine with C6/7 listhesis with cord injury |
| 5C | X Ray showing lateral view of c spine injury with C6/7 listhesis and burst fracture of C6 |
| 6A | Sagittal section of whole spine showing the compressive myelopathy of cervical spine with prolapsed D11/12 disc with cord compression |
| 6B | X Ray cervical spine with Ankylosing Spondylosis with fracture of C6 vertebra |
| 6C | Sagittal cut of CT showing ankylosing spondylosis with C5/C6 fracture |
| 6D | X Ray lateral view showing post op C5/6 fixation |
| 7A | X Ray cervical spine lateral view with C2/3 listhesis |
| 7B | Transverse section of C2 with fracture |
| 7C | Sagittal section of CT of dorsolumbar spine with fracture D12/L1 |
| 8A | Sagittal section of CT showing cervical spine injury with cord transection at C4/5 level |
| 8B | Sagittal section of MRI with fracture L2 with spinal canal disruption |
| 8C | Sagittal section of CT cuts of L2 fracture |
| 8D | Axial section of CT cuts of L2 fracture |
| 9 | Sagittal section of CT showing fracture of C1 and disruption at the level of C1/2 level |

# INTRODUCTION

Spinal cord injury (SCI) is a debilitating neurological condition with socioeconomic impact on affected individuals as well as the health care system. Spinal cord injury (SCI) remains one of the most devastating incidents to happen to an individual. This not only has multispectral negative impacts on the affected individual, but also on their family members, society, and the nation as a whole. Etiologically, more than 90% of SCI cases are traumatic and caused by incidents such as traffic accidents, assault, sports, or fall from height[1]. According to the National Spinal Cord Injury Statistical Center, there are about 12,500 new cases of SCI each year in North America[2]. SCI commonly results from a sudden, traumatic impact on the spine that causes fractures or vertebral dislocation.

The male-to-female ratio of 2:1 for SCI, happens more frequently in adults compared to children. Men are mostly affected during their early and late adulthood (3rd decade and 8th decade of life) [1]. The age distribution is bimodal, with a first peak involving young adults and a second peak involving those over the age of 60 years[3]. The highest prevalence of traumatic spine injury was seen in age group 15-45 years old, which can be justified by the fact that younger men, as an active group of the community, tend to spend more time outdoors and are therefore at higher risk for trauma, whereas women spend more time at home and face lower trauma risks, especially in rural areas but are more prone for osteoporosis. In India as per estimates, incidence of spinal injury is around 15 to 20 per million population per year. According to a report by the World Health Organisation, 82% of the victims of SCI are male, with the majority of them (56%) in the age group of 16–30 years. To make the matter more worse, 50–60% of them remain unemployed following the injury[4]. Such injuries have tremendous consequences on the overall resource allocations in many developing and underdeveloped nations.

Traumatic spinal injuries comprise of either column fractures or spinal cord injuries or both. Vertebral fractures occur due to force

applied to spinal structures. It takes a relatively stronger force to cause a vertebral fracture in healthy bone tissue, but when a bone is weakened due to various causes, vertebral fractures can result from trivial trauma[5]. Spine injuries have a great impact on patients, their families, and society. It may lead to serious disability when involving the spinal cord with long-term medical complications, including pressure ulcers, autonomic dysreflexia, deep venous thrombosis and pneumonia. People with spinal injury have a high level of mental distress, depression, anxiety, and suicide thoughts because of their low levels of life satisfaction. The cost of treatment of spine injuries and its impact on the health care system is high[4]. Every year, around the world, between 2,50,000 - 5,00,000 people suffer a spinal cord injury (SCI) due to various reasons. The majority of spinal cord injuries are due to preventable causes such as road traffic crashes, fall from height, or violence. Fall from height is the most common cause in Southern Asia. People with a spinal cord injury are two to five times more prone to die prematurely than people without a spinal cord injury, with worse survival rates in low-income and middle-income countries. Re-admission rates within a year of injury for such patients are as high as 27.5%. One cross-sectional study from the US Healthcare System found that 95.6% of SCI patients had at least one medical complication at the time of their routine annual check-up. Spinal cord injury is associated with low rates of school enrolment and economic participation, and it carries substantial high individual and societal costs[5]. High-quality radiological investigations are essential for the diagnosis and management of patients with spinal trauma. The clinical outcomes of SCI depend on the severity and location of the lesion and may include partial or complete loss of sensory and/or motor function below the level of injury. Lower thoracic lesions can cause paraplegia while lesions at the cervical spine level is associated with quadriplegia[6].

Patients who present with complete spinal cord injuries, without any discernible motor or sensory preservation on the neurological examination have a very poor prognosis. On the other hand patients

with incomplete spine injury regain a significant amount of neurological function, they may be spared progression into a complete injury with rapid diagnosis, and treatment of fracture elements, hematoma, and other compressive lesions[7].

Kang et al (2017) review reported that the cervical level of the spine was the most common part of spine to be injured in both developed countries and underdeveloped countries[8]. In the thoracolumbar region, L1 was the commonest site of fracture followed by T12, L4, L2-L3, T11, and T5[7]. As per Indian estimates, an incidence is of around 15-20 per million population per year [9]. The United Nations has recently implemented the "Decade of Action for Road Safety" to reduce this problem globally [10]. SCI typically affects the cervical spine of the spinal cord (50%) with the single most common level affected being C5 (1). Other injuries include the dorsal spine level (35%) and lumbar region (11%). SCI patients often survive these traumatic injuries and live for decades after the initial injury[11].

Motor vehicle accidents (MVA) are the principal cause of spine trauma which account for approximately 40% of reported cases. Other injuries are typically the result of a fall from height or sporting activities [12]. The 40-year survival rate of these individuals was 47 and 62% for persons with quadriplegia and paraplegia, respectively[11]. The life expectancy of SCI patients highly depends on the level of injury and preserved functions. For instance, patients with ASIA Impairment Scale (AIS) grade D who require a wheelchair for daily activities have an estimated 75% of normal life expectancy, while patients who do not require a wheelchair and catheterization can have a higher life expectancy of up to 90% of that of a normal individual[13].

The traumatic spinal cord injury (SCI) encompasses a great deal of pain and mental trauma due to disability for patients and their caregivers. To fight this dreaded situation, a deep understanding of various aspects like management issues, complications, new developments, etc is essential. It is also very important to make proper guidelines for such patients and training of the medical individual.

Identification of local problems in transportation and caregiving is also to be taken into consideration[9].

**Classification of vertebral fractures:**

Several methods are used for the classification of vertebral fractures, most of them are based on the mechanism of injury or anatomical changes and have limited clinical use as they are not on basis of quantifiable parameters. Based on Denis's three-column theory of spinal stability, the spine is divided into anterior, middle, and posterior 1/3rd columns each[14]. Vertebral fractures should be classified on basis of neurological deficit, mechanical compression/ instability, and spinal canal deformity[15,16]. Classification on basis of morphology, takes into account the loss of height of the vertebral body, the location of the vertebral fracture[17]:

- Wedge fracture, usually involves the anterior or less commonly posterior edge of the vertebral body
- Concave or biconcave fracture, involves the central part of a vertebra
- Crush fracture involves a combination of the anterior, posterior as well central part of the vertebra.

Grade 1: vertebral body height > 75% of normal value

Grade 2: vertebral body height is between 50-75% of normal value

Grade 3: vertebral body height <50% of normal value.

In vertebral fractures, the spinal canal is compromised due to translation and intrusion of vertebral body fragments into spinal canal damaging the spinal cord and nerve roots leading to neurological deficits[16].

**Flexion–compression mechanism (wedge or compression fracture)**

Flexion and compression forces combined cause the anterior wedge compression fracture of spine with variable involvement of middle and posterior compartments[17,18]. There are three subtypes: In the first one, only the anterior column of spine is disrupted which is a stable fracture. This results in anterior wedge fracture of the vertebral

body. The loss of anterior vertebral body height is usually <50%. In the second pattern, there is an anterior column involvement and posterior column ligamentous failure as well, which is potentially unstable fracture. Imaging reveal anterior wedge compression fracture and increased interspinous distance. The loss of vertebral body height is usually >50%. In the third type, there is the failure of all three columns which is an unstable fracture. Imaging studies demonstrate anterior wedging and posterior vertebral body disruption. Displaced bone fragments into the spinal canal may cause compression of the spinal cord or nerve roots.

**Axial-compression mechanism (burst fracture)**

The axial compression forces on the spine cause the burst fracture (also known as a crush fracture). This kind of spine injury is associated with high-energy impacts. Burst fractures are most commonly found at the dorso-lumbar junction between D5 and D8[19]. A burst fracture is characterized by a loss of height in the vertebral body. The fracture is usually seen in anterior and middle columns; the state of the posterior column determines whether the fracture is stable or unstable [20]. The displacement of posterior elements and/or vertebral body or facet dislocation or subluxation is seen in unstable fractures. Displacement of bone fragments into the spinal canal may cause compression of the spinal cord or nerve roots, as well as vascular injury leading to neurological deficits.

**Flexion-distraction mechanism (Chance fractures)**

The combination of flexion and distraction forces cause Chance (or seatbelt) fracture of spine. This is usually seen in dorsolumbar injury in which the posterior column is involved with injury to ligamentous and bony components, or both. Chance fractures are often associated with intra-abdominal organ injuries[21]. The pathophysiology of injury depends on the axis of flexion of spine. Several subtypes exist. In Chance fracture, mostly the axis of flexion is anterior to the anterior longitudinal ligament (ALL). This results in a horizontal fracture of the bony elements along with disruption of the supraspinous ligament. On axial CT scans, the fracture lines through

pedicles are seen as a gradual loss of definition of the pedicles; this appearance is also called the “dissolving pedicle sign”[21]. With more severe flexion-distraction forces, the axis of flexion lies behind the anterior longitudinal ligament. The Chance fractures can be accompanied by a burst-type vertebral fracture with posterior cortex buckling or retropulsion into spinal canal. This is an unstable injury. Moreover, if the pars interarticularis is disrupted, the instability of the spinal column is increased, and can lead to significant subluxation. Neurological deficits, when present, are related to the degree of compression of the neural elements.

**Rotational fracture -dislocation mechanism**

The precise mechanism of this fracture is a combination of lateral flexion and rotation of spine with or without a component of posterior-anteriorly directed force to vertebral column. The resultant injury pattern is the injury to both the posterior and middle columns with varying degrees of anterior column injury. The rotational force is cause for the disruption of the posterior ligaments and facet joints. With sufficient rotational force, the upper vertebral body rotates and carries the superior portion of the lower vertebral body along with it. This causes the radiographic “slice” appearance sometimes seen with these types of injuries.

**PATHOPHYSIOLOGY OF THE SPINAL C6ORD INJURY:**

Spinal cord injury can be due to primary or secondary mechanisms as described below:

**PRIMARY INJURY TO THE SPINAL CORD:**

The primary mechanism consists of the direct damage to the spinal cord tissue perpetrated by a direct trauma on the spinal cord parenchyma. Among various possible factors are direct impacts with persistent or transient compression, vertebral fracture and displacement, and cord laceration or transection, missile damage (such as in gunshot-related SCI), laceration, shear damage, and distraction.[22,23]

**SECONDARY INJURY TO THE SPINAL CORD:**

The aforementioned list of possible mechanisms of damage causes a focal neuronal and oligodendrocytes injury resulting in a blood-spinal-barrier (BSB) interruption with increased spinal cord parenchyma permeability and subsequent changes in the concentration of the electrolyte beyond the BSB, with altered sodium and calcium channel function. Direct neurons and oligodendrocytes damage along with damage to the microvasculature, result in focal ischemia and a cellular swelling evolving in cellular death with the release of pro-inflammatory factors, vasoactive peptides, and cytokines, in response to which, there is increased permeability including the inflammation of cells promoting further tissue damage. Among the possible pathogenesis of such focal ischemia, mechanical damage-related vasospasm, micro-hemorrhages, and focal thrombosis caused by platelet aggregation, oxygen free radicals have been advocated. Cellular excess of oxygen free radicals species is formed in response to focal ischemia, because of an incomplete transformation process operated by the Dismutase/Catalase enzyme system during the electron transport in the mitochondrial oxygen metabolism chain. This results in progressive peroxidation of the cellular inner membrane causing a dysfunction of the phospholipids-dependent enzymes, among which cGMP and $Na^+/K^+$ ATPase, with subsequent alteration of the membrane gradients and cellular death, circularly resulting in further damage.[24]

The cord swelling tends to peak after 3 to 6 days and subsides slowly over weeks. This acute phase appears to be followed by a progressive neuron degeneration mediated by persistent inflammation and characterized by extensive microglial and astroglial activation.

**EVALUATION OF SPINE INJURY:** Both clinical and radiological assessment:

**CLINICAL ASSESSMENT:**

Early recognition of traumatic spinal cord injury in the field is crucial to avoid additional cord damage during transportation. However,

the early evaluation of any patient with traumatic spinal cord injury includes:

- Sensory, motor examination of reflexes
- Careful exclusion of other serious injuries such as to the head, chest, abdomen and pelvis
- Respiratory failure because of loss of diaphragmatic function
- Refractory hypotension and bradycardia due to neurogenic shock (loss of sympathetic outflow along with unopposed vagal activity)
- Spinal shock typically presenting with reflex flaccid paralysis with anaesthesia below the level of lesion.

**RADIOLOGICAL ASSESSMENT:**

The main objective of the radiological examination in the clinical setting is to depict the spinal axis and detect spinal trauma rapidly and accurately and to guide potential surgical decompression. Several imaging modalities can be used, but nowadays multi-detector computed tomography (MDCT) and magnetic resonance (MR) imaging are the most important imaging modalities [11].

**Plain X-ray films**

Plain X-ray films are a 'quick' way to assess the spine. They are readily available in most hospitals and trauma centers. Plain radiographs may be helpful in fracture screening, and are mainly used to detect a spinal deformity.

Indications for obtaining "screening" radiographs of the thoracic and lumbar spine in patients with blunt injuries include: back pain, fall from a height of 10 feet or more, Ejection from a motorcycle/motor vehicle crash at 50 mph or more, Glasgow coma scale (GCS) score at admission <8, and neurological deficit [25].

The "National Emergency X-Radiography Utilization Study (NEXUS) Low-Risk Criteria (NLC)" was first described in 1992 [26]. More recently, the "Canadian C-Spine Rule (CCR)" was developed for use with alert (GCS = 15) in stable cervical spinal trauma patients [27]. For alert trauma patients who are in stable condition, the CCR was found to be superior to the NLC with respect to sensitivity and

specificity for cervical spine injury [28]. Plain X-ray films even with the best possible technique, underestimate the amount of traumatic spine injury, and lesion(s) may be missed.

**(Multidetector) computed tomography (CT)**

Computed tomography (CT), and in particular MDCT, plays a critical role in the rapid assessment of the polytrauma patient [29]. Early on, many trauma centers adopted the technique of thin-section CT with reformation in sagittal or coronal planes to evaluate the spine. CT screening has a higher sensitivity and specificity for evaluating cervical spine injury compared with plain film radiographs[30-32]. In the cervical spine, CT detects 97-100% *of* fractures. Many major trauma centers nowadays have replaced plain film radiographs with spiral CT or MDCT as the standard of care in the initial evaluation of the cervical spine in moderate to severe trauma patients.

The most important limitation of CT is the inability to provide screening for ligamentous injury and spinal cord lesions. Traditionally, CT of the thoracic and lumbar spine is commonly performed to evaluate suspicious levels on plain film studies, or to evaluate the patient with a known level of injury. Recent literature data indicate that MDCT diagnoses thoracolumbar spine fractures more accurately than plain X-ray films.[33,34]

**Magnetic resonance imaging (MRI):**

MR imaging is the preferred technique for the detection of soft tissue injuries [35]. It is mainly used to exclude occult injuries and to identify spinal cord lesions [36]. MR imaging is the investigation of choice for assessing traumatic lesions involving the intervertebral discs and spinal ligaments[37]. It has been recommended that cervical spine trauma patients with negative standard radiographs and suspected occult cervical injury should be investigated by MR imaging to detect ligamentous injuries that were not seen on plain X-ray studies [38]. A more recent study showed that, in cervical spine trauma, MR imaging was highly sensitive for injury to the intervertebral disc (93%), posterior longitudinal ligament and interspinous soft tissues (100%), but was less sensitive in assessing injury to the anterior

longitudinal and flavum ligaments [39]. MR imaging is able to reveal the location and severity of the lesion and, at the same time able to indicate the cause of spinal cord compression [40]. This is especially useful in the management of patients with incomplete spinal cord injury, for whom surgical intervention may prevent further deterioration [40]. Several types of traumatic spinal cord lesions can be found: intramedullary hemorrhage, spinal cord contusion/edema, extrinsic compression by a bone fragment or a traumatic disc herniation, and complete transection of the cord [35]. MR imaging helps in predicting neurological recovery [36]. Neurological recovery is usually insignificant in patients with intramedullary hemorrhage or cord transection, whereas patients with cord edema or contusion may significantly recover from neurological dysfunction [41].

**NEUROLOGICAL ASSESSMENT OF SPINE INJURY:**

A detailed neurological examination is necessary to determine the level of the injury and the severity of the neurological impairment.

1. Frankel Scale

2 ASIA (American Spinal Cord Injury Association) Scale

3. Modified Rankin Scale (MRS).

1) **The Frankel Scale** synthesizes the neurological conditions of the patient affected by SCI, considering the residual sensory or motor functions below the injury level"; it is classified into five groups of patients[42]:

A- Patients with a full motor and full sensory deficit.

B-Patients with full motor palsy but with some residual sensory function below the level of lesion.

C-Residual motor function but not useful for an independent life.

D- Reduced strength in concern to the motor function which is besides useful.

E- Normal neurological function.

2) **ASIA Scale**, the ASIA score (and subsequent revised versions) overcomes the limitations concerning the simplified "below the injury level' concept. Furthermore, the sensory function evaluation is dermatome-based, which is extremely accurate for every single

dermatome. The anorectal sphincter function evaluation was definitively introduced.

A = Complete: No sensory or motor function is preserved in sacral segments S4-S5

B = Incomplete: Sensory, but not motor, function is preserved below the neurological level and extends through sacral segments S4-S5

C = Incomplete: Motor function is preserved below the neurological level, and most key muscles below the neurological level have a muscle grade of less than 3

D = Incomplete: Motor function is preserved below the neurological level, and most key muscles below the neurological level have a muscle grade that is greater than or equal to 3

E=Normal: Sensory and motor functions are normal

3) The **modified Rankin scale** is commonly used to quantify functional outcomes in individuals who suffer a neurological event.

0: no symptoms/normal.

1: no significant disability despite symptoms; able to carry out all usual duties and activities.

2: slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance,

3: moderate disability; requiring some help, but able to walk without assistance.

4: moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance.

5: severe disability; bedridden, incontinent, and requiring constant nursing care and attention.

6: dead.

Although Traumatic Spinal Cord Injury (TSCI) is potentially preventable condition, it is essential to understand the epidemiology and the clinico-radiological profile of SCI to target high risk groups and take preventive measures effectively. In addition, updated knowledge of local prevalence as well as the epidemiological profile of SCI is important for the strategic planning of clinical and supportive measures. At the individual level, information about the prognosis, morbidity and

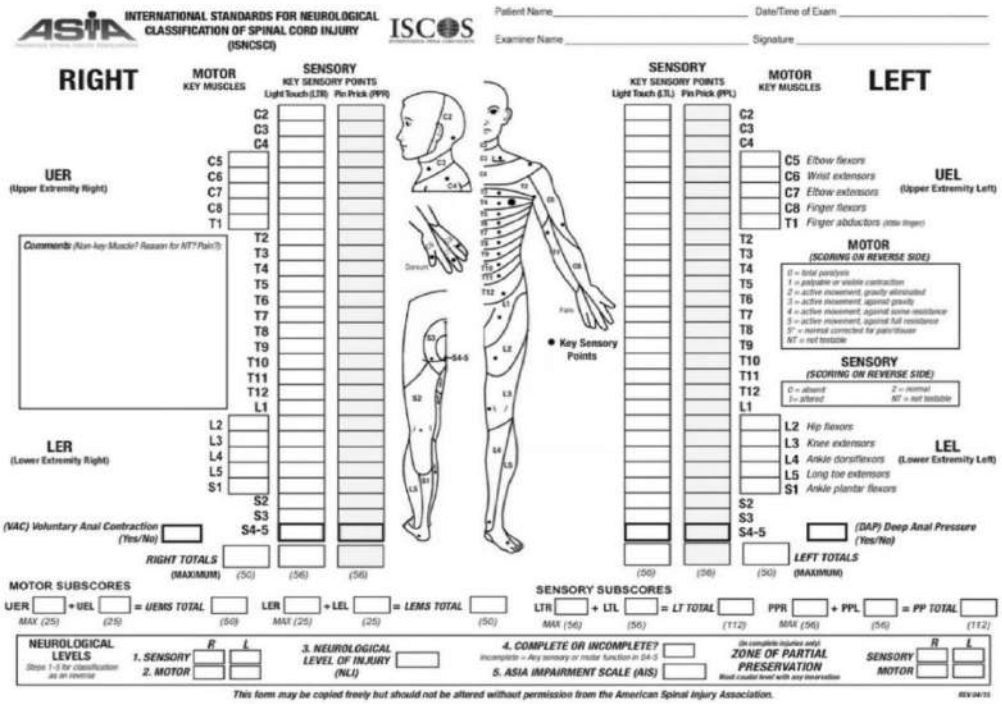
mortality is necessary to answer patient's questions about their functional capabilities and to provide effective and efficient neuro-rehabilitation for spine injury patients with neurological deficit.

In the clinical management of patient with Spinal cord injury, neurological outcomes are generally determined after 72 hrs after injury using the ASIA scale[43,44]. This time point has been shown to provide a more precise assessment of neurological impairments after SCI [45]. One important predictor of neurological recovery is to determine whether the spinal cord injury is incomplete or complete. As time passes, SCI patients experience spontaneous improvement of motor and sensory functions. Much of the neurological recovery occurs during the first 3 months and in most patients reaches a maximum by 9 months after injury [43]. However, additional recovery can occur up to 12–18 months post spinal cord injury [43]. Long-term outcomes of SCI are assessed by the level of the injury, the severity of the primary injury, and the progression of the secondary injury.

Depending on the level of SCI, patients experience paraplegia or quadriplegia. Paraplegia is defined as the impairment of sensory or motor function in the lower extremities/limbs [44,45]. Patients with incomplete paraplegia generally have a good prognosis of regaining neurological ability (~76% of patients) within a year of injury[44]. Patients with complete paraplegia experience complete recovery of lower limb function if their neurological level of injury is above D9 level [46]. An NLI below D9 is associated with a 38% chance of regaining some lower limb neurological function [46]. The neurological level of injury (NLI) is defined as "the most caudal neurological level at which all sensory and motor functions are normal". In patients with complete paraplegia, the chance of recovery to an incomplete status is only 4% with only half of these patients regaining lost bladder and bowel control [46]. Quadriplegia is defined as partial or total loss of sensory or motor function in all four limbs. Patients with incomplete quadriplegia will have better recovery than complete quadriplegia and paraplegia [47]. Unlike in complete SCI, recovery from incomplete tetraplegia usually happens at multiple levels below the NLI [43]. Patients generally reach a

plateau of recovery within 9–12 months after injury [43]. Regaining some motor power within the first month after the spinal injury is associated with a better neurological outcome [43]. Moreover, the appearance of muscle flicker (local involuntary muscle contractions) in the lower extremities is highly associated with recovery of neurological function [22]. Patients with complete quadriplegia, often (66–90%) regain function at one level below the injury [45,47]. Importantly, initial muscle strength is an important predictor of functional recovery in these patients [43]. Complete quadriplegic patients with cervical SCI can regain antigravity muscle function in 27% of the cases when their initial muscle strength is 0 on a 5-point scale [48]. However, the rate of regaining antigravity muscle strength at one caudal level below the injury increases to 97% when the patients have initial muscle strength of 1–2 on a 5-point scale [49].

An association between sensory and motor recovery is demonstrated in SCI where spontaneous sensory recovery usually follows the pattern of motor recovery [43,50]. Maintenance of pinprick sensation at the zone of partial preservation or in sacral segments has been shown as a reliable predictor of motor recovery [51]. One proposed reason for this association is that pinprick fibers in the lateral spinothalamic tract travel in the proximity of motor fibers in the lateral corticospinal tract, and thus, the preservation of sensory fibers can be an indicator of the preserved motor fibers [43]. Diagnosis of an incomplete spinal injury is of great importance. Failure to detect sensory preservation at sacral segments results in an inaccurate assessment of the prognosis [43].




PICTURE 1: ASIA scoring table

| Modified Rankin Scale (MRS) |
|---|
| 0 No symptoms |
| 1. No significant disability, despite symptoms; able to perform all usual duties and activities |
| 2. Slight disability; unable to perform all previous activities but able to look after own affairs without assistance |
| 3. Moderate disability; requires some help, but able to walk without assistance |
| 4. Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance |
| 5. Severe disability; bedridden, incontinent, and requires constant nursing care and attention |
| 6. Death |

PICTURE 2: MR Scale

| | |
|---|---|
| Frankel A (FA): complete injury | No motor or sensory function clinically detected below the level of the injury |
| Frankel B (FB): preserved sensation only | No motor function clinically detected below the level of the injury; sensory function remains below the level of the injury but may include only partial function (sacral sparing qualifies as preserved sensation). |
| Frankel C (FC): preserved motor non functional | Some motor function observed below the level of the injury but is of no practical use to the patients. |
| Frankel D (FD): preserved motor functional | Useful motor function below the level of the injury, patient can move lower limb and walk with or without aid, but does not have a normal gait or strength in all motor groups. |
| Frankel E (FE): normal motor | No clinically detected abnormality in motor or sensory function with normal sphincter function. |

PICTURE 3: Frankel Scale

# AIMS AND OBJECTIVES

1. To determine clinico-radiological profile of spinal injuries in our institute.
2. To identify prognostic factors and determine outcome.

**Karamehmetoglu SS, Unal S, Karacan I et al. (1995)[52]** did a retrospective study conducted on all new patients with a traumatic spinal cord injury (SCI) in 1992. In that year 152 new traumatic SCI were identified. The estimated annual incidence was 21 per million population. The male/female ratio was 3:1. The mean age was 33, 34 for male patients and 31 for female patients. 72% of all patients were under the age of forty. The major causes of SCI were falls (43%) and car accidents (41%), followed by being struck by an object (7%), gunshot injury (5%), and stab injury (2%). Fifty patients (33%) were tetraplegic and 102 (67%) paraplegic. Regarding the tetraplegic patients the commonest level was C5, in those who were paraplegic commonest level was L1. The commonest associated injury was head trauma, followed by fractures of an extremity (or extremities). Accidental falls (exceeding road accidents) were mostly due to falls from buildings and accidents on work premises.

**Otom AS, Doughan AM, Kawar JS, Hattar EZ (1997)[53]** conducted a retrospective study in 151 traumatic spinal cord injury patients who were admitted to the spinal unit during the period January 1988 to December 1993. The estimated annual incidence was 18 per million populations. The majority were predominantly males (85.4%) the male/female ratio was 5.8:1. The mean age at the time of injury was 33 being 30.9 years for males and 34.8 years for females. There were 68% (n = 103) with paraplegia and 32% (n = 48) with tetraplegia. The commonest etiology was motor vehicle accidents (44.4% n = 67), next came bullet injuries (25.8% n =39), followed by accidental falls (21.2% n = 32).

**Igun GO, Obekpa OP, Ugwu BT, Nwadiaro HC (1999)[54]** did a retrospective study for Spinal cord injury (SCI) between 1994 and 1997. The mean age of presentation was 30 year and sex ratio Male: Female was 10:1. Vehicular accidents accounted for 49 percent of SCIs and collapsed tunnels for 26 percent of spinal cord injury and were the two most common causes. Fracture dislocation of the spine

(unstable) occurred in 52 per cent and flexion wedge fractures (stable) in 14 per cent. Ten per cent of patients had no neural deficits presentation, 21 per cent had partial cord lesions and 69 per cent complete cord lesion. Hospital mortality was 26 percent of cases.

**Surkin J, Gilbert B, Harkley H, Sniezek J, Currier M (2000)**[55] conducted a 2-year study from 1992 to 1994 and reported that in 395 confirmed cases of SCI the overall crude incidence rate among patients in hospitals and pre-hospital fatalities was 77 SCI per million population per year. Excluding pre-hospital deaths, the incidence rate was 59 per million populations per year. Most persons with confirmed cases of SCI were male (80.0%), and the incidence rate of SCI among males was 4.4 times higher than among females. The rate of SCI was highest among persons 20-24 years of age, and in this age group the rate was 5.2 times higher for males than females. The incidence rate for black males was higher than that for white males in every age group and was 1.9 times higher overall. The SCI rate was similar for black females and white females. The most frequent cause of SCI was motor vehicle crash (or collision), followed by violence (including intentional injuries from gunshot wounds and assaults) and falls. The remaining cases were caused by pedestrians being struck by an automobile, diving injuries, all-terrain vehicle crashes, bicycle crashes, and football injuries. Data from the surveillance system showed that among persons who sustained an SCI in a motor vehicle crash, only 8% used a safety belt; 75% used no seat belt; and in 17% of cases, belt use could not be determined. Among the 293 persons admitted to hospitals with SCI, most (87.7%) had severe impairment of neurological function below the injured spinal cord segment (Frankel class A, B, or C). Function in the affected segments was substantially preserved (Frankel class D) in 6.5% of cases, 5.5% of them sustained no permanent neurological deficit (Frankel class E), and it was unknown what functional impairment was sustained in 0.3%. Among patients with a known level of injury, tetraplegia was diagnosed in 52.3% of them and paraplegia in 47.7% of them. Among the 395 persons with confirmed SCI, 40.7% died by the end of the study period. Among those who

died, 56.5% of them died before reaching a hospital. Among the 234 patients leaving acute care or rehabilitation facilities, 80.3% of them were discharged home and required only self-care or family care, 8.1% of them were discharged home and needed skilled care, and 6.0% of them were discharged to a nursing facility. For the remaining 5.6% of them of patients, the final discharge disposition was unknown.

**Pickett W, Simpson K, Walker J, Brison RJ (2003)** [56] reported that two thousand three hundred eighty-five patients with spinal cord injuries were identified over the 5-year period of surveillance (1994-1999). They found that the annual age-standardized rates declined over time, from a maximum rate of 46.2 spinal cord injury hospitalizations per 1 million populations in 1994/95 to 37.2 per 1 million in 1998/99. Men experienced higher rates of spinal cord injury than women, and male rates declined over the 5-year period, whereas female rates remained stable. The lowest rates and frequencies were observed in children younger than 10 years for both sexes. The highest rates were experienced by those 70 years and older, with a modest peak among 20- to 29-year-old men. Sex ratios also differed by age group. In the youngest (10 years) and oldest (70 years) age groups, ratios of male-to-female injury rates were less than 1.5:1, whereas in the age groups from 10 to 69 years, these ratios ranged from 2.2 to 3.5:1. Unintentional falls (1,030 of 2,385 [43.2%]) and transport incidents (1,021 of 2,385 [42.8%]) were the leading external causes of injury. The predominant external cause among those 60 years and older was unintentional falls (506 of 711 [71.2%]). In particular, falls on the same level as a result of slipping, tripping, or stumbling (121 of 506 [23.9%]) and falls from stairs or steps (93 of 506 |18.4%]) occurred frequently. Transport incidents were a leading cause of injury, and these accounted for 53.8% (170 of 316) of hospitalization in those younger than 20 years of age and 57.0% (447 of 784) of hospitalizations in those between 20 and 39 years of age. There were 41 injuries involving motorcycles in those between the ages of 20 and 39 years. Homicides and injuries purposely inflicted by another person were predominately observed among the 20 to 39 year age group (29

of 52 [55.8%]), as were suicides and self-inflicted injuries (19 of 34 [55.9%]).

**Calancie B, Molano MR, Broton JG (2005)[57]** in their study of 229 patients with spinal cord injury reported that the male subjects constituted 76.4% (n = 175) of the population studied. Their average age at the time of injury was 39.8+16.8 years. Female subjects in their study had age characteristics that closely matched those of the male subjects (40.5+19.9 years [range 7.1-83.5 years]). Fifteen of 229 subjects were children (11 boys) [15.7 +3.2 years] and (4 girls) [13 .8 +4.7 years]). Motor vehicles were the most common cause of SCI (43.2%) followed by fall (19.7%). Cervical fracture accounted for 62% of their caseload. Thirty-five subjects (15 %) sustained fractures between T1 and T10 (inclusive), and thoracolumbar fracture (T11 through L4) was seen in 44 subjects (19 %). An additional 7 subjects (3 %) had clinical findings of cervical level SCI but had no radiologic evidence of spine damage. They attempted to follow each subject's neurologic recovery for up to 3 years and it was found that seventeen of their subjects (7.4%) died during 3-year follow-up period. The average period between injury and death was 0.4±05 years, ranging between 1 and 26 months. They found that the majority of these subjects were reliant upon ventilator support since the time of their injury and died of Pulmonary insufficiency. Three subjects died of complication associated with traumatic spinal cord injury Gastrointestinal bleeding and pulmonary embolus.

**Roche SJ, Sloane PA, McCabe JP (2008)[58]** in their study of 51-month period, a total of 286 cases of traumatic spinal injury were reported. The cohort comprised 175 males (61.4%) and 111 females (38.6%). The overall male to female ratio was 1.58:1. Two patients were pregnant at the time of injury. The annual incidence of traumatic spinal injury presenting to the unit was 19.54 per 100,000 persons per year. The mean length of stay for this cohort was 15.5 days (range 1-97 days). Twenty percent of the cases were of polytrauma (n = 56). The most common age group at which spine injury occurred was at 20-24 years of age (range 11-92). A second peak of injury occurred in the

75- to 79-year-old. For males, the peak incidence was at age 20. For females, there were two peaks of spinal injury, at ages 19 (n = 5) and 76 years (n = 5). The causes of spine trauma seen in this cohort were broadly divided into two groups: falls occurring in 172 cases (60.35%) and motor vehicle accidents (MVAs) in 97 cases (34.04%). The remainder was caused by other mechanisms (5.61%) of cases. For both sexes the pattern of injury etiology was almost identical. Motor vehicle accidents MVAs comprised 91 cases due to car or motorcycle accidents (93.82%), 2 pushbike accidents (2.06%), 2 boating accidents and 2 in which pedestrians sustained trauma to the spine. The remainder (16 cases) were due to other etiology including direct trauma (7), three due to lifting weights, two atraumatic in nature and two in which spinal trauma was caused by being crushed by a weight after having fallen. The mechanism was unknown in two other cases. Traumatic spinal injury (Overview); In 285 patients there were a total of 380 injuries to the vertebral column consisting of 366 fractures, 8 subluxations, 2 fracture-subluxations and 1 dislocation. Two-hundred and eight (56.83%) of the 366 vertebral fractures were solitary while the remainder occurred in 66 patients as multilevel injury. Each patient with multilevel injuries sustained a mean of 2.4 fractures. The overall mean number of fractures was 1.3 per patient with a median value of 1 fracture per patient. On average, females Sustained traumatic spinal injury at an older age than males. The mean age of male injury was 41.46 years (range 13-92 years) for those with solitary fractures compared to 52.38 years (range 11-85 years) for females. The average age of a patient sustaining multiple spinal fractures was 41.05 years for males (range 11-86 years) compared to 48.91 for females (range 15-92 years). Twenty-two patients (19 males and 3 females) sustained multi-regional fractures. Of those with multiregional injuries, 6 sustained 3 or more fractures. The most common multi-regional injury comprised fractures of the bodies of T12 and L1 (n = 10). Fourteen of the 285 patients had abnormal findings on neurological examination (4.91%). The male: female ratio for positive neurological findings was 3.67:1. This figure contrasts markedly with the overall male to female ratio of

1:58 suggesting that males are much more likely than females to sustain a neurological injury as a result of sustaining spine trauma in the context of this study. Six patients had upper limb neurological findings (42.86%) and four had lower limb findings (28.57%). Four patients were quadriplegic (28.57%). Notably, more than 60% (63.64%) of male neurological findings occurred in patients under the age of 50 years, while the female group with a mean age of 64.67 years tended to sustain neurological damage at an older age. The mechanism of injury in these 14 patients consisted of nine falls (64.29%), four motor vehicle accidents (28.57%) and one case in which the patient was crushed following a fall. It is clear that falls were the major cause of neurological injury in this patient cohort. Of the nine falls, eight occurred from a height. Falls from animals led to the neurological injury in 28.57% of cases. Of the total cases with neurological injury, there were six cases of trauma to the cervical spine (42.86%), two to the thoracic spine (14.29%). one to the Lumbar spine (7.14%), and four to the sacral spine (28.57%). Eighty-four percent of patients were managed entirely conservatively. A further 8% of them were treated with either skull traction or a halo vest. Two percent underwent surgery at the study hospital. A further 4% were transferred either home (i.e., United States) or to the National Spinal Injuries Unit at the Mater Hospital, Dublin, Ireland. The remainder (2%) of them was treated multimodally (i.e., surgery + halo brace).

**Hagen EM, Eide GE, Rekand T, Gilhus NE, Gronning M (2010)** [59] did a retrospective study aimed to include all inhabitants who sustained a TSCI in the period 1952-2000. Of 336 patients, 199 patients were alive on 1 January 2002, giving a total prevalence of 36.5 per 100000 inhabitants. The average annual incidence increased from 5.9 per million in the first decade to 21.2 per million in the last. The mean age at injury was 42.9 years and the male to female ratio was 4.7:1. Fall was the most common cause of injury (45.5%), followed by motor vehicle accidents (MVA) (34.2%). The incidence of MVA-related injuries increased during the observation period, especially among men <30 years. The lesion level was cervical in 52.4%, thoracic in 29.5%,

and lumbar/sacral in 18.2% patients. The lesion was clinically incomplete in 58.6% and complete in 41.4% of patients. The incidence of fall-related injuries and the proportion of incomplete cervical lesions increased during the observation period, especially among men >60 years.

**Feng HY, Ning GZ, Feng SQ, Yu TQ, Zhou HX (2011)** [60] in their retrospective study reviewed medical records of 239 patients with traumatic spinal cord injuries admitted to the hospital from 1998 to 2009. Variables included were gender, age, marital status, Occupation, etiology, time of injury, level, and severity of the injury. Over this period, they found that the mean age of patients with traumatic spinal cord injury was 45.4 +14.1 years, and the male/female ratio was 4.6:1. In all, 86.2% of them were married. The leading cause was fall (52.3%) of them, followed by motor vehicle collisions (36.4%) of them. The most common injury site was the cervical spinal cord, accounting for 82.0%. Incomplete tetraplegia made up for 59.4%, followed by complete tetraplegia (22.6%) of them. Eight patients died after operation, and among the eight patients, seven had cervical injuries and one had an injury at the level of T11. In the end, four died from respiratory failure, two died from acute pulmonary embolism, and two died of multiple organ failure. Rahimi-Movaghar V et al (2013)" included 64 studies from 28 countries and demonstrated that the incidence of SCI in developing countries is 25.5/million/year and ranges from 2.1 to 130.7/million/year. Males comprised 82.8% of all SCIs with a mean age of 32.4 years. The two leading causes of SCI were found to be motor vehicle crashes (41.4%) and falls (34.9%). Complete SCIs were found to be more common than incomplete injuries (complete SCI: 56.5%; incomplete SCI: 43.0 %). Similarly, paraplegia was found to be more common than tetraplegia (paraplegia: 58.7%; tetraplegia: 40.6%).

**Lofvenmark I, Norrbrink C, Nilsson-Wikmar L, Hultling C, Chakandinakira S, Hasselberg (2015)**[61] in their descriptive study of 49 patients reported that the annual incidence of SCI was 13 per million population. Male comprised 71% of all with age ranging from 4

to 81 years, 80% were< 45 years. Tetraplegia was more common than paraplegia (59/41%), and about 39% had C1-C4 level of injury. The main cause of TSCI was Road traffic accidents (68%), followed by assault (16%) and falls (10%). Mortality was 20%, where all, but one, had tetraplegia (18%). Median time from injury to spinal surgery was 12 days, with longer time for women, 16 days compared with 8 days for men. Burst tire was the primary cause of road traffic causes resulting in a TSCI, followed by hitting animals on the road.

**Mathur N, Jain S, Kumar N, Srivastava A, Purohit N, Patni A (2015)**[62] in their study from 2000 t0 2008 about 2716 cases of SCI were reported, 1400 were cervical and 1316 thoracolumbar, with male to female ratio of 4.2:1 and 71% in the age group of 20-49 years. Around 79% patients were from rural background. About 23.3% were farmers while 22.9% were labourers. Among the causes of injury, 53% patients had a fall from height and 28% suffered from road traffic accidents. Fall of heavy object overhead and back (10.7%), fall with heavy object overhead (3.0%) and fall following electric shock (4.0%) were uncommon causes. Complete paralysis was found in (20.5%) cervical and (23.3%) in thoracic injuries. Extremity and rib fractures (10.6%) and head injuries (7.2%) were common associated injuries. About 55% cases were initially attended at non- specialized centers.

**Derakhshanrad N, Yekaninejad MS, Vosoughi F, Sadeghi Fazel F, Saberi H (2016)**[63] in their study reported 1137 cases of spinal injury, with a mean age of 29.1 years, 79.2% of them being male (M/F-3.8/1). Rough estimation of TSCI prevalence in Tehran province was 2.36 per 100000 population. Regarding etiology, 61.8% were due to motor vehicle accident (MVA), followed by falling 24.5%, heavy drop 5.2%, violence 3.8%, sport 2.8% and others causes 1.9%. Regarding injury level, 31.5% were cervical, 57.9% thoracic and 10.6% lumbar. Complete lesions were 53.5% of patients and 46.5% were incomplete. Most common neurological type was T1-S5 (American Spinal Injury Association Impairment Scale: A, B, C [61.7%]). Most common complications included urinary tract infection followed by pressure sore (grade Ⅲ and Ⅳ [37.5%]), autonomic dysreflexia (37%) and

neuropathic pain (31.2%). Substance abuse was observed in 8.8% of cases.

**Joseph C, Andersson N, Bjelak S, Giesecke K, Hultling C, Nilsson Wikmar L, et al (2017)[64]** in their study of 18-month period, 49 incident cases were registered, of whom 45 were included in this study. The crude incidence rate was 19.0 per million, consisting mainly of men (60%), and the mean age of the cohort was 55 years (median 58). Causes of injury were almost exclusively limited to falls and transport-related events, account for 58% and 40% of cases, respectively.

**Halvorsen A, Pettersen AL, Nilsen SM, Halle KK, Schaanning EE, Rekand T(2019)[65]** performed a 5-year period (2012-2016) study and found that the lowest incidence of TSCI was 11.4/million (2012), and the highest incidence was 15.9/million (2014), In the study period, 349 individuals were registered with TSCI. In total, 76% were male, and the mean age was 47 (Standard Deviation -19) years. They observed dominance in the 60-74 years age group. The distribution between tetraplegia and paraplegia was 48% and 42% respectively. For those initially classified as American Spinal Cord Injury Association Impairment Scale (AIS) grade A (complete injury), 77% remained grade A at discharge. Considerable changes during primary rehabilitation after incomplete lesions were observed. Most patients (68%) were discharged home after primary rehabilitation. Falls were the main cause of TSCI (47%) and occurred more often during the weekend.

**Liu J, Liu HW, Gao F, Li J, Li JJ (2020)[66]** reported Five hundred and ninety patients with TSCI admitted from 1st January 2011 to 31st December 2019. They collected data on sex, age, marital status, etiology, occupation, neurological level of injury, and the American Spinal Injury Association Impairment Scale on admission, time of injury and treatment. They found that the mean age of patients with TSCI was 46.3 + 15.5 years, and the male/female ratio was 4.73:1. The incidence of TSCI increased gradually with age and peaked in the 40 49 age groups. The most common occupation was worker (28.6%) followed by office clerk (16,8%) and retired (15.4%). Fall from heights

(30.8%). followed by traffic accidents (27.6%) and low falls (25.1%), are the leading etiology of TSCI. A majority of patients (54.9%) had cervical injuries, 91.9/% underwent surgical treatment, and the lowest number of injuries was recorded during winter (19.6%).

**Johansson E, Luoto TM, Vainionpää A et al (2020)[67]** in a 4-year period of their study, 346 new patients with TSCI were admitted to the study centers and found that the mean annual incidence of TSCI was 36.6 per million. The leading causes of injury were low level falls (36.2%), high-level falls (25.5%), and transport-related accidents (19.2%). In the patients >60 years, 72.6% were injured by falling and the proportion of low-level falls was 49.7%. In the patients 60 years old, 47.4% were alcohol-related. The proportion of cervical injuries in the patients >60 years was 77.1%, while in the patients 60 years the proportion was 59.6%. The incidence of TSCI was higher during the summer and autumn months

# MATERIALS AND METHODS

## SOURCE OF DATA

- The patients presented to Dayanand Medical College and Hospital emergency, Ludhiana, Emergency with traumatic spine injury were taken into study group. The study period extended from 1st September 2021 to 31st August 2022.

## METHODS OF COLLECTION OF DATA

- Detailed clinical and neurological examinations were performed in all patients. MRI screening of whole spine was performed for all patients who had any of the factors such as - severe mode of injury, spinal pain or tenderness, age older than 60 years, patients with neurological deficit.
- Data extracted includes - Age, socioeconomic status, gender, etiology, severity, management, complications and outcome.
- For classifying injury severity, American spinal injury association (ASIA) scale was used. Outcome was defined by the state of the patient during and after discharge and based on modified rankin scale (MRS). Statistical analysis was done using SPSS (statistical package for social science).

## INCLUSION CRITERIA

- All the patients with spinal injury with or without neuro deficit.

## EXCLUSION CRITERIA

- Pathological fractures and fractures due to systemic prolonged illness.

## DURATION OF STUDY

- This study was conducted in the department of neurosurgery Dayanand medical college and hospital, Ludhiana over a period of 1 year from 1st September 2021 to 31st August 2022 and included all the patients with spinal injuries presented to department of neurosurgery, Dayanand medical college and hospital during this period.

## STATISTICAL ANALYSIS

- Data was described in terms of range; mean ±standard deviation (± SD), median, frequencies (number of cases) and relative frequencies (percentages) as appropriate. All statistical calculations were done using (Statistical Package for the Social Science) SPSS 21version (SPSS Inc., Chicago, IL, USA) statistical program for Microsoft Windows.

## MANAGEMENT PLAN

- Patients were managed according to the neurological examination and radiological findings and appropriate management plan was decided whether surgical or non-surgical. ICU care and ventilator and inotropic support was given as and when required.

## OUTCOME

- Outcome was assessed at the end of hospital-discharge and on regular follow up at 1 month and 6 months. Outcome was graded as: no recovery (no evidence of clinical improvement in the nerve function), partial recovery (some objective clinical recovery), or complete recovery (at the end of the follow-up period, the patient was asymptomatic). Outcome was measured by modified Rankin Score (MRS) and classified into slight disability, moderate disability, moderately severe disability, severe disability.

# OBSERVATIONS AND RESULTS

We had a total of 43 patients with spinal injuries who presented to department of neurosurgery over a period of one year from 1st September 2021 to 31st August 2022.

TABLE 1: GENDER DISTRIBUTION

| **SEX** | No. of cases | Percentage |
|---|---|---|
| FEMALE | 9 | 20.9% |
| MALE | 34 | 79.1% |
| Total | 43 | 100.0% |

In our study male patients outnumbered female patients with a male to female ratio of 3.78:1. This reflects that spine trauma is more common in males as compared to females.

FIGURE 1: PIE DIAGRAM SHOWING GENDER DISTRIBUTION

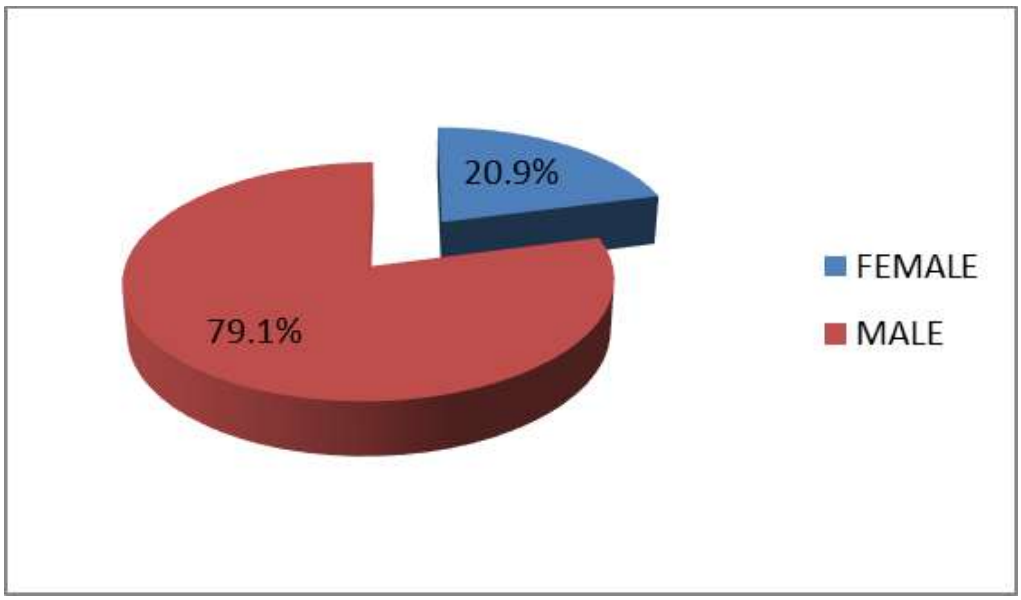


TABLE 2: AGE DISTRIBUTION

| **AGE GROUP** | No. of cases | Percentage |
|---|---|---|
| < 30 | 15 | 34.9% |
| 31-40 | 4 | 9.3% |
| 41-50 | 10 | 23.3% |
| 51-60 | 6 | 14.0% |
| > 60 | 8 | 18.6% |
| Total | 43 | 100.0% |

The patients were aged between 18 – 87 years with mean age being 44.55 years. Of the total 43 patients with spine trauma ,majority of patients i.e. 15 (34.9 %) were seen in age group less than 30 years, followed by 41-50 age group (23.3%).

FIGURE 2: BAR DIAGRAM SHOWING AGE DISTRIBUTION

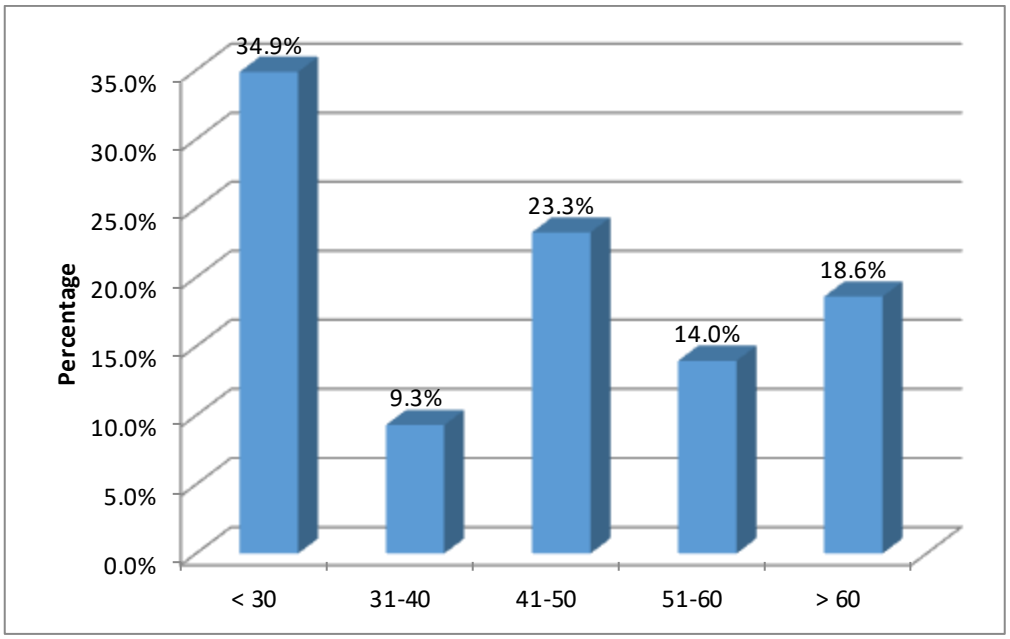


TABLE 3: OCCUPATION DISTRIBUTION

| SL.NO | OCCUPATION | FREQUENCY | PERCENT |
|---|---|---|---|
| 1 | BUSINESS | 6 | 13.9 |
| 2 | STUDENT | 14 | 32.5 |
| 3 | FARMER | 12 | 27.9 |
| 4 | HOMEMAKER | 6 | 13.9 |
| 5 | DEPENDENT | 5 | 11.6 |

In our study, majority of spinal injuries were seen in students (32.5% of cases), followed by farmers (27.9%), businessmen and homemaker (13.9% of cases each), dependent/elderly (11.6%of cases).

FIGURE 3: PIE DIAGRAM SHOWING OCCUPATION DISTRIBUTION

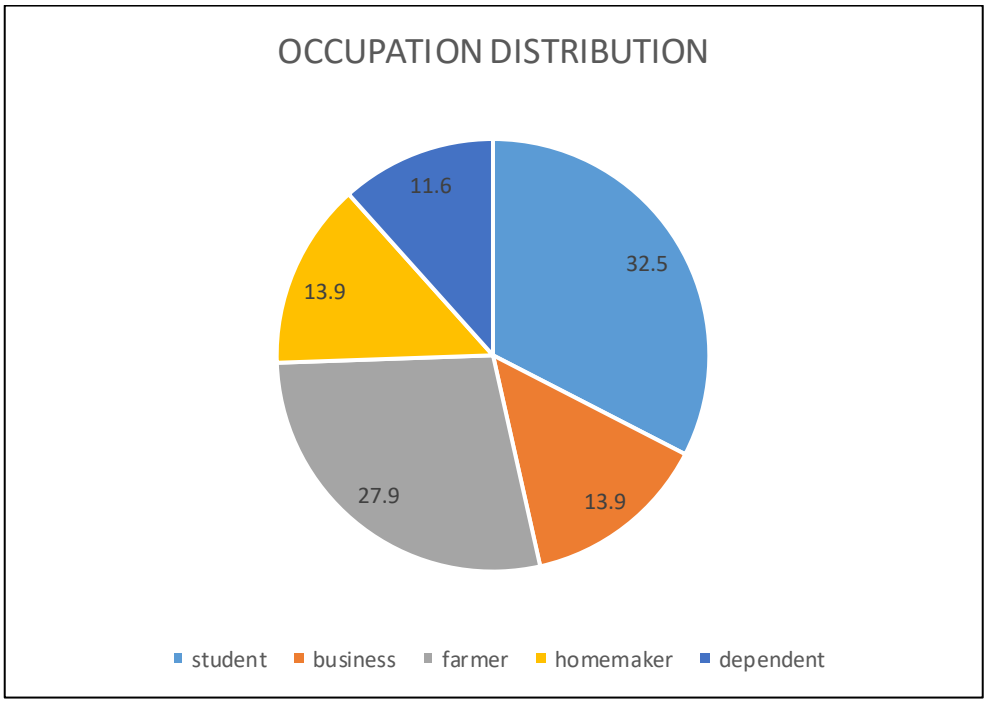


TABLE 4: MODE OF INJURY

| **MODE OF INJURY** | No. of cases | Percentage |
|---|---|---|
| FALL | 15 | 34.9% |
| RSA | 28 | 65.1% |
| Total | 43 | 100.0% |

In our study, road side accident was the most common cause of spinal injury which accounted for 65.1%of cases followed by history of fall (34.6%)

FIGURE 4: PIE DIAGRAM SHOWING MODE OF INJURY

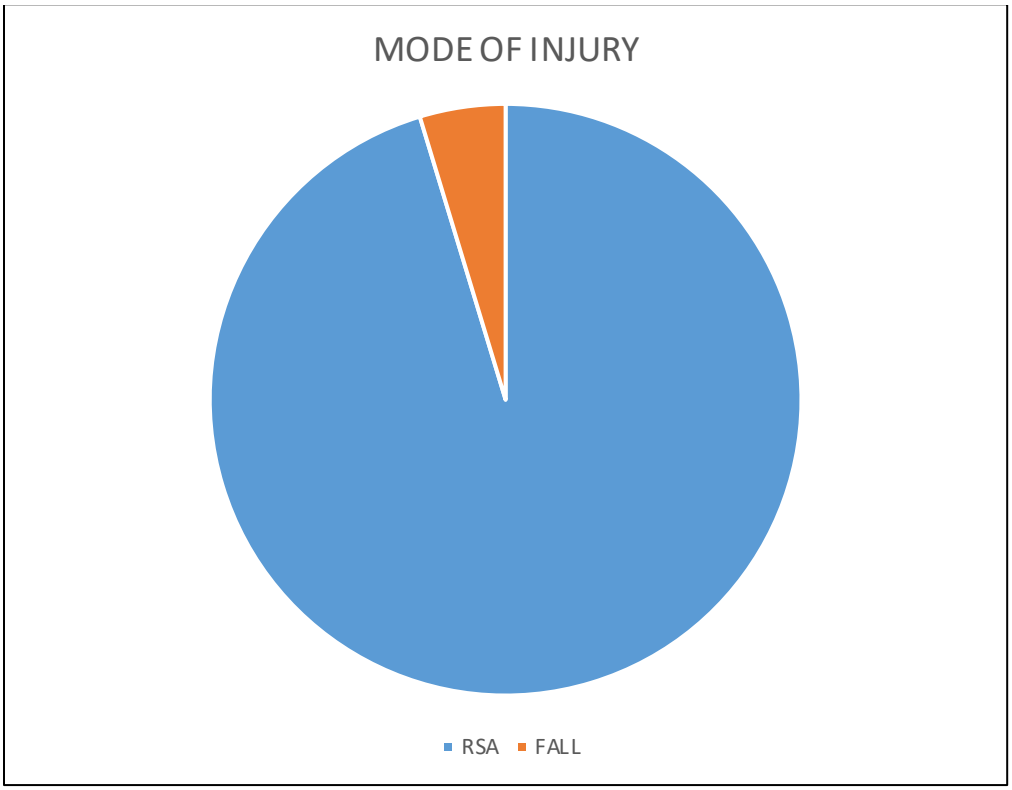


TABLE 5: TIME OF INJURY

| TIME OF INJURY | FREQUENCY | PERCENT |
|---|---|---|
| 6AM-12PM | 4 | 9.3% |
| 12PM-6PM | 15 | 34.8% |
| 6PM-12AM | 21 | 48.3% |
| 12AM-6AM | 3 | 6.9% |

Most of the injuries were observed to have happened during 6pm to 12 am which accounted for 48.3% of cases followed by 12 pm to 6 pm (34.8%), 6am to 12 pm (9.3%) and 12 am to 6 am (6.9%). Most of the patients suffered injuries driving post alcohol consumption/drug intoxication.

FIGURE 5: BAR DIAGRAM SHOWING TIME OF INJURY

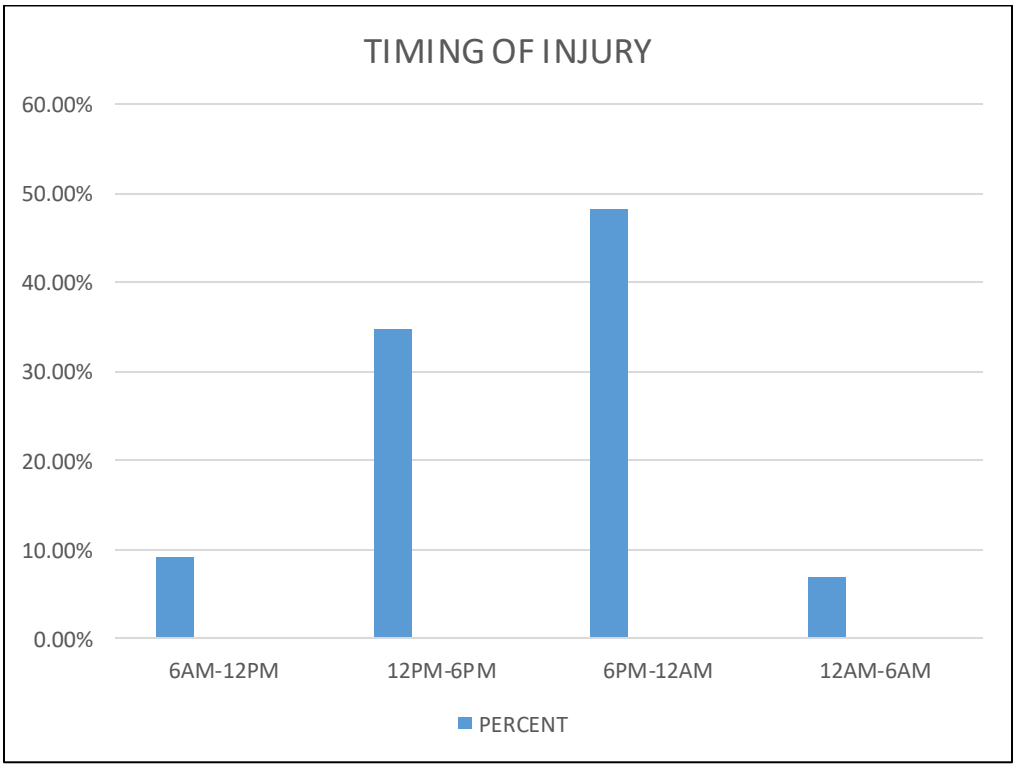


TABLE 6: SHOWS SEASONAL INCIDENCE OF SPINE INJURIES

| SEASON DISTRIBUTION | FREQUENCY | PERCENT |
|---|---|---|
| WINTER (DECEMBER, JANUARY, FEBRUARY) | 19 | 44.1 |
| SPRING (MARCH, APRIL, MAY) | 6 | 13.9 |
| SUMMER (JUNE, JULY, AUGUST) | 10 | 23.2 |
| AUTUMN (SEPTEMBER, OCTOBER, NOVEMBER) | 9 | 20.9 |

In our study, most of the spinal injuries happened in winter season which accounted for 44.1% (N=19), about 23.2%(N=10) occurred in summer, 20.9%(N=9) in Autumn and 13.9%(N=6) in spring season. Most of the injuries occurred in winter due to low visibility and high incidence of RSA in winters.

FIGURE 6: BAR DIAGRAM SHOWING SEASONAL DISTRIBUTION OF SPINE INJURIES

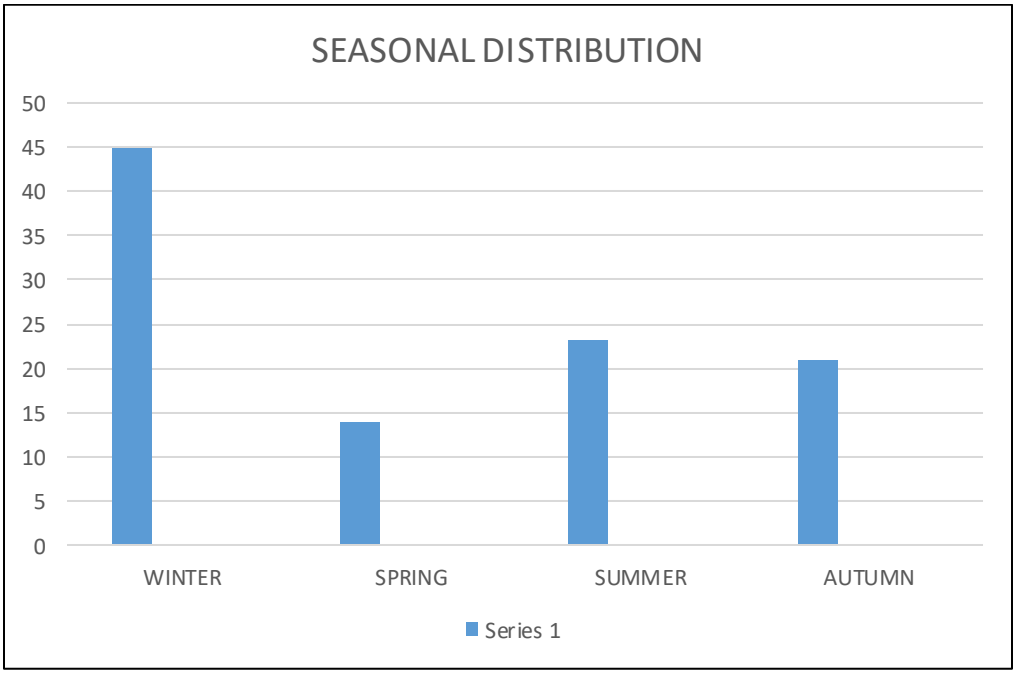


TABLE 7: TABLE SHOWING TYPE OF VEHICLE INVOLVED IN RSA

| TYPE OF VEHICLE | FREQUENCY | PERCENT |
|---|---|---|
| 4 WHEELER | 17 | 60.8 |
| 2 WHEELER | 11 | 39.2 |

Most of spine injuries presented due to road side accidents to our institute involved light motor vehicles which accounted for 17 ( 60.8 %) followed by two wheeler which happened to be the mode of transport in 11 patients (39.2%).

FIGURE 7: BAR DIAGRAM SHOWING THE TYPE OF VEHICLE INVOLVED IN RSA

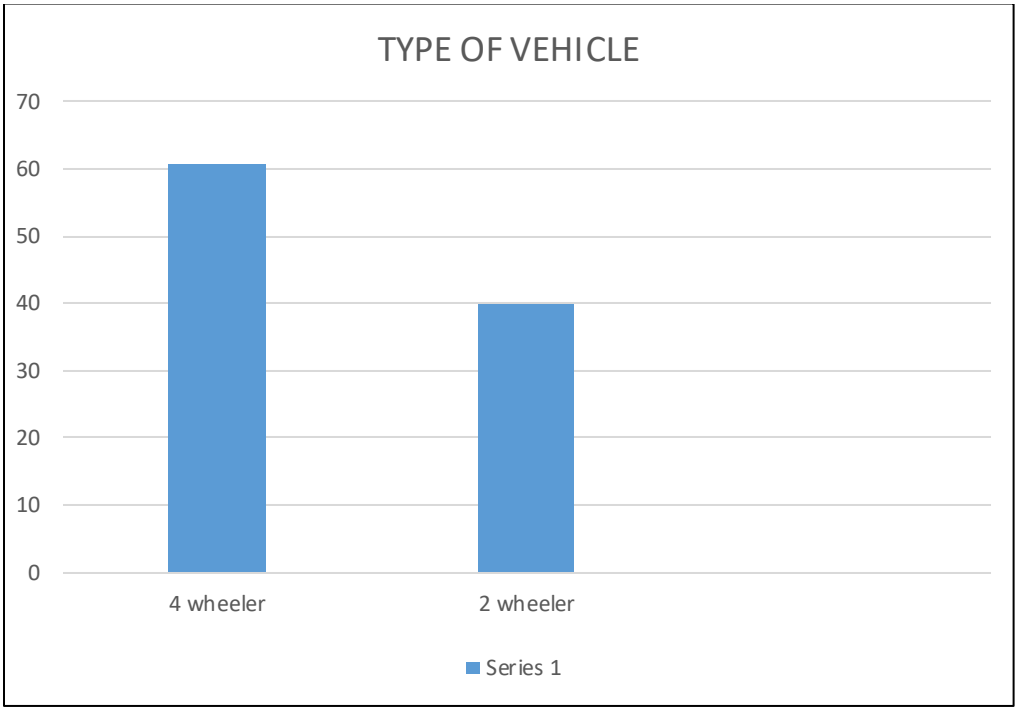


TABLE 8: TABLE SHOWING MODE OF INJURY DUE TO FALL

| SL NO | FALL | FREQUENCY | PERCENT |
|---|---|---|---|
| 1 | BALCONY | 4 | 26.6 |
| 2 | STAIRS | 5 | 33.3 |
| 3 | ELECTRIC POLE | 1 | 6.66 |
| 4 | BATHROOM | 5 | 33.3 |

In our study, spine injury with history of fall accounted for (15 patients) 34.8%, of which 5 patients (33.3%) each accounted for fall from stairs and in bathroom, one patient (6.66%) fell from electric pole and 4 (26.6%) accounted for fall from balcony.

FIGURE 8: PIE DIAGRAM SHOWING MODE OF INJURY DUE TO FALL

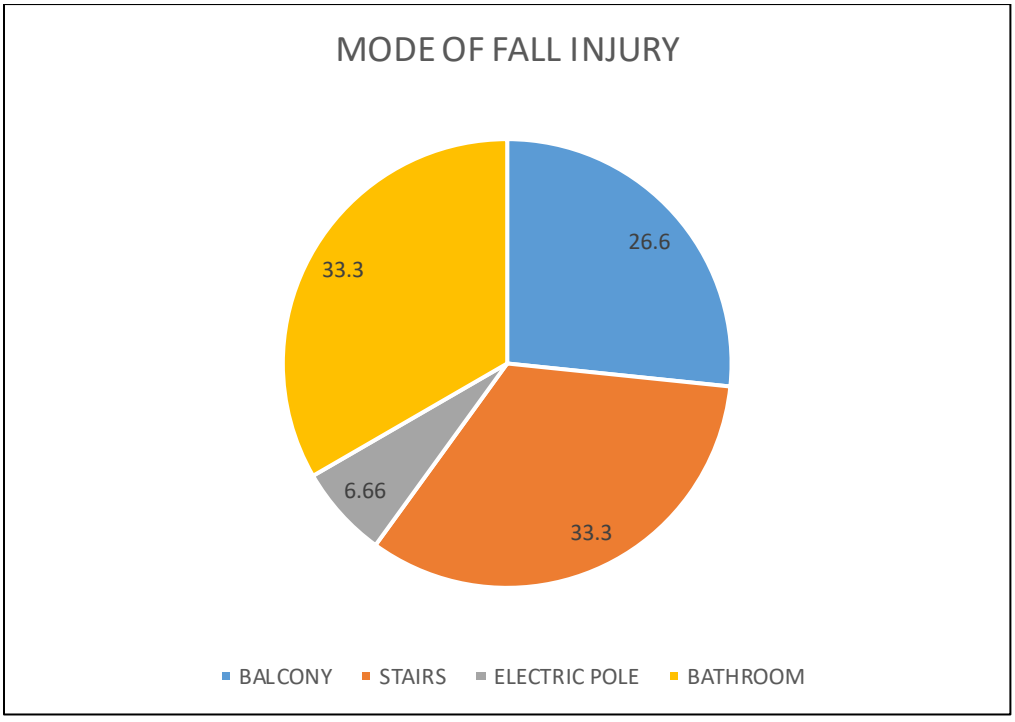


TABLE 9: TABLE SHOWING PATIENTS GCS AT ADMISSION

| **GCS GROUP** | No. of cases | Percentage |
|---|---|---|
| < 8 | 4 | 9.3% |
| 9-12.0 | 6 | 14.0% |
| 13-15.0 | 33 | 76.7% |
| Total | 43 | 100.0% |

In our study, Glasgow Coma Scale at the time of admission was analysed, most of the patients (76.7% of them) were admitted with GCS 13-15 and about 14% of them were admitted with GCS 9-12 and 9.3% were admitted with GCS <8 respectively.

FIGURE 9: BAR DIAGRAM SHOWING GCS AT ADMISSION

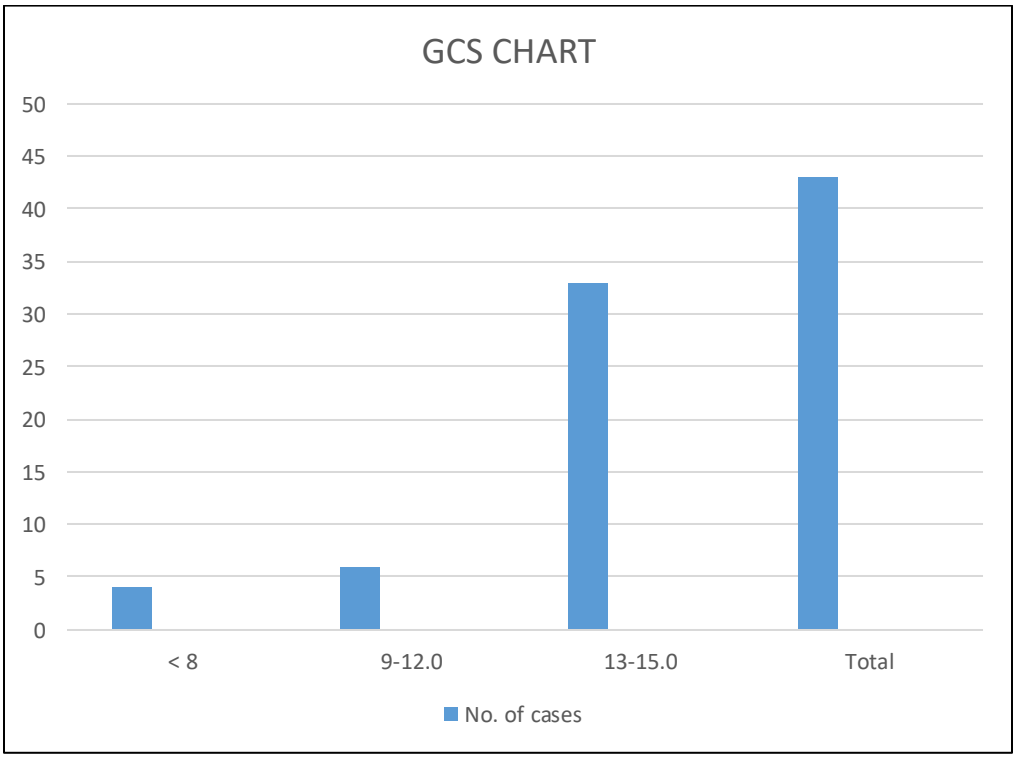


TABLE 10: TABLE SHOWING ASIA SCORE AT TIME OF ADMISSION

| **ASIA SCORE** | No. of cases | Percentage |
|---|---|---|
| A | 25 | 58.1% |
| B | 2 | 4.7% |
| C | 2 | 4.7% |
| D | 6 | 14.0% |
| E | 4 | 9.3% |
| NOT APPLICABLE | 4 | 9.3% |
| Total | 43 | 100.0% |

In our study, About 58.1 % (n=25) of patients who presented with spine injury in our institute had ASIA grade A at the time of admission followed by 14% (N=6), 9.3%(N=4), 4.7% (N=2) of cases with ASIA grade D, E, B and C respectively. In about 9.3 % (N=4) of patients ASIA grade couldn't be determined at the time of admission because patient had low GCS at the time of admission.

FIGURE 10: PIE DIAGRAM SHOWING ASIA SCORE AT ADMISSION

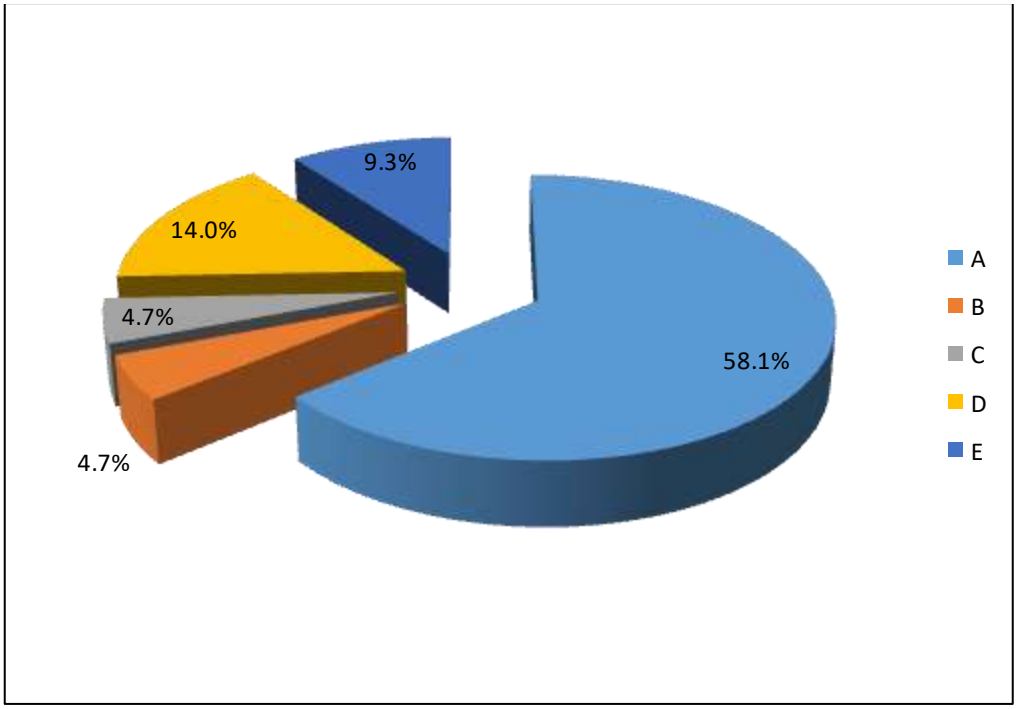


TABLE 11: TABLE SHOWING LEVEL OF SPINE INJURY

| LEVEL OF INJURY | FREQUENCY | PERCENT |
|---|---|---|
| CERVICAL | 34 | 79.0% |
| THORACIC/DORSAL | 4 | 9.3% |
| CERVICOTHORACIC | 2 | 4.7% |
| LUMBAR | 3 | 7.0% |
| Total | 43 | 100.0% |

In our study, about 79.0% (N=34) of spine injuries occurred in cervical region followed by 9.3%(N=4), 7%(N=3), 4.7% (N=2) of cases in dorsal region, lumbar region and cervicothoracic region respectively.

FIGURE 11: PIE DIAGRAM SHOWING LEVEL OF SPINE INJURY

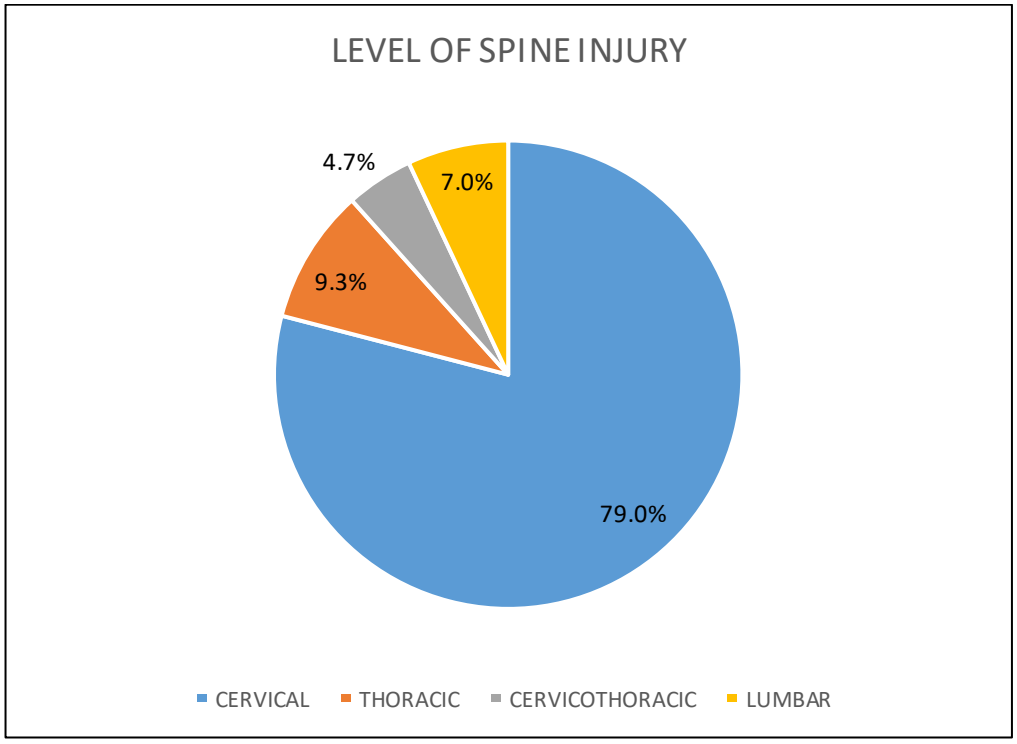


TABLE 12: TABLE SHOWING LEVEL OF FRACTURE DISTRIBUTION

| LEVEL OF INJURY | FREQUENCY | PERCENT |
|---|---|---|
| SINGLE LEVEL | 40 | 93% |
| TWO LEVEL | 2 | 4.6% |
| MORE THAN 3 LEVEL | 1 | 2.3% |

In our study, about 93 % of patients had single level fracture followed by two level fractures in 4.6% and 2.3 % of them had fractures in more than 3 levels.

FIGURE 12: BAR DIAGRAM SHOWING LEVEL OF FRACTURE DISTRIBUTION

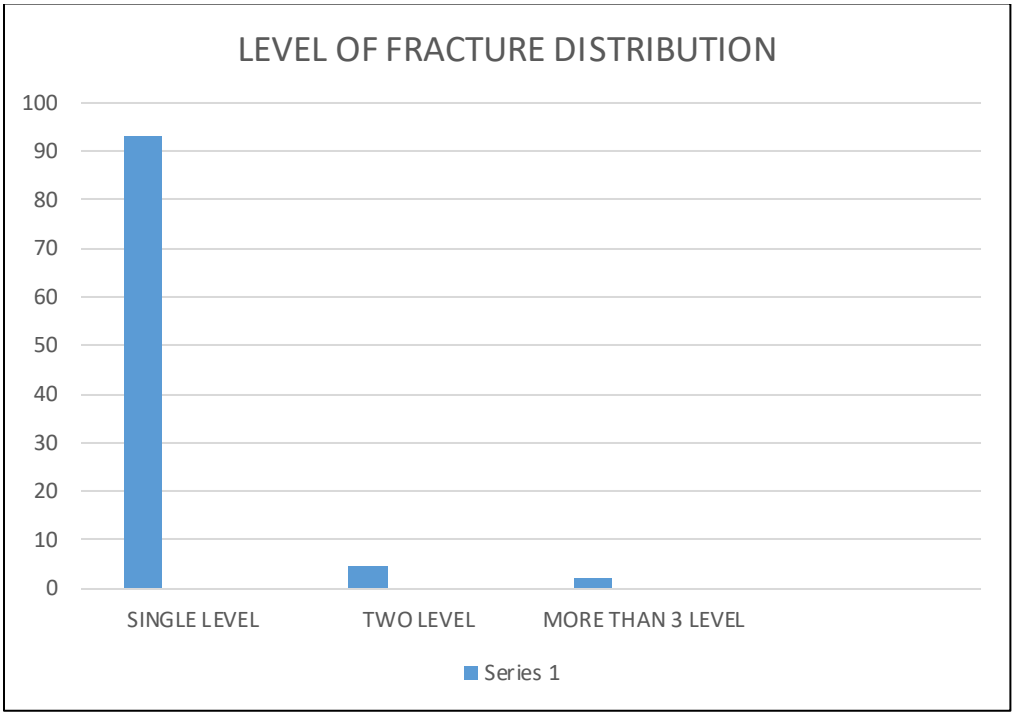


TABLE 13: TABLE SHOWING THE TYPE OF SPINAL FRACTURE

| TYPE OF FRACTURE | FREQUENCY | PERCENT |
|---|---|---|
| BURST | 17 | 39.5 |
| WEDGE FRACTURE | 7 | 16.25 |
| SUBLUXATION | 14 | 32.5 |
| ODONTOID FRACTURE | 2 | 4.65 |
| HANGMAN FRACTURE | 1 | 2.32 |
| SPINOUS PROCESS | 2 | 4.65 |

In our study, the most common type of fractures were burst type which accounted for about 39.5 % (N= 17), followed by 32.5 %, 16.25 %, 4.65 %, 2.32 % of cases were subluxation, wedge fractures, odontoid fractures and spinous process, hangman fracture respectively.

FIGURE 13: BAR DIAGRAM SHOWING TYPE OF SPINAL FRACTURE

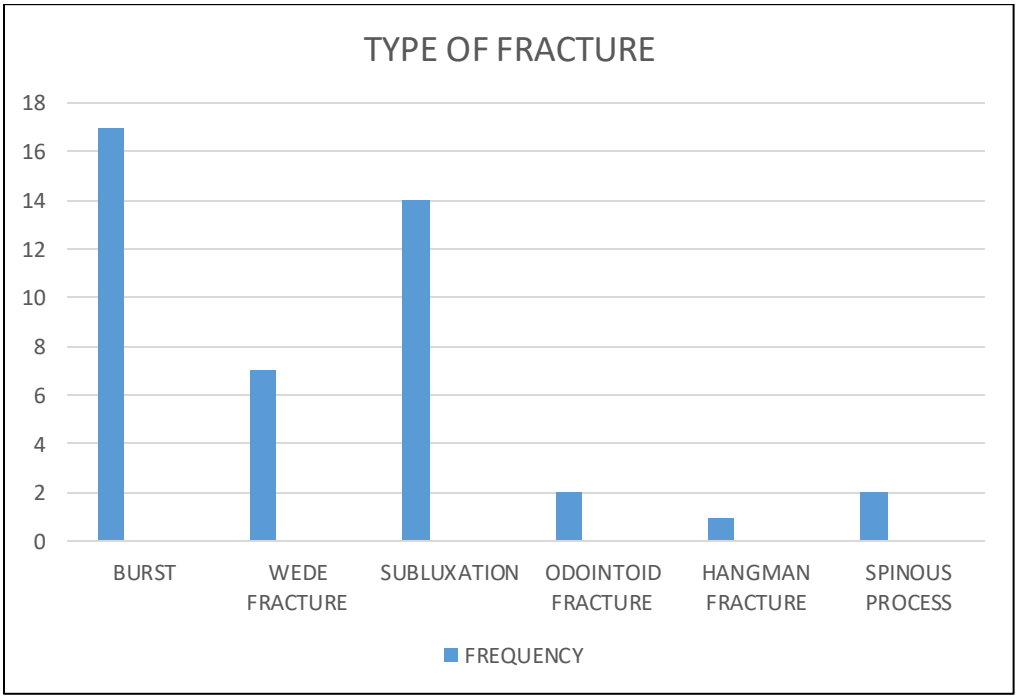


TABLE 14: TABLE SHOWING LISTHESIS WITH FRACTURE

| **LISTHESIS** | No. of cases | Percentage |
|---|---|---|
| NO | 29 | 67.4% |
| YES | 14 | 32.6% |
| Total | 43 | 100.0% |

In our study, about 32.4 % of spine injury patients have shown associated listhesis along with fractures , and no listhesis was seen in 67.4% of patients.

FIGURE 14: PIE DIAGRAM SHOWING LISTHESIS WITH FRACTURE

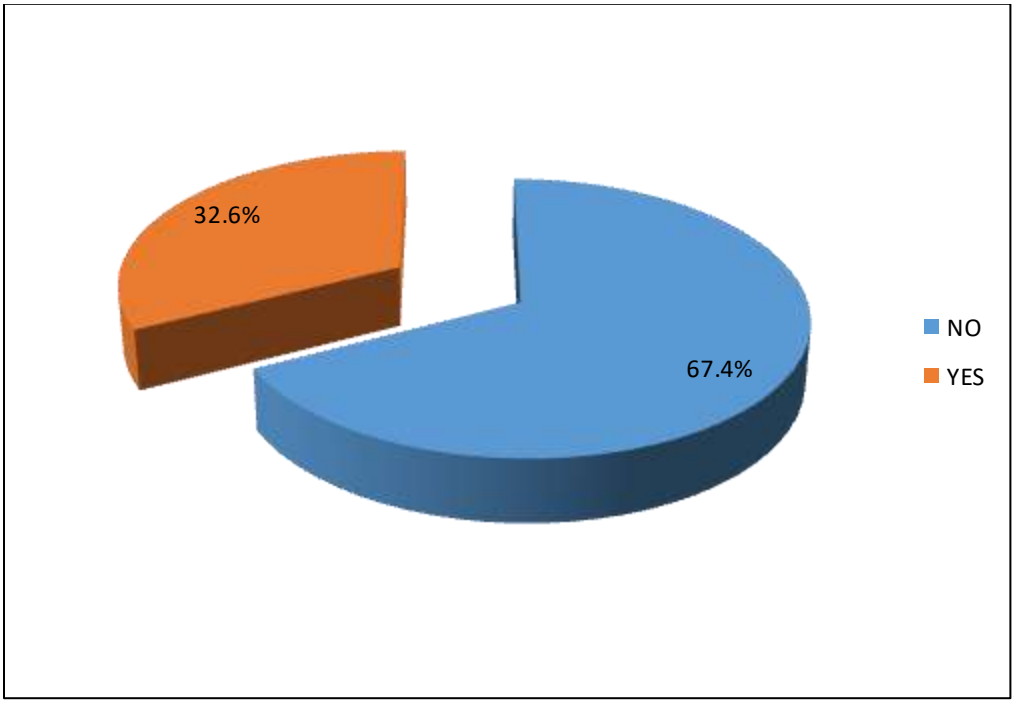


TABLE 15: TABLE SHOWING NEUROLOGICAL DEFICIT

| **NEUROLOGICAL DEFICIT** | No. of cases | Percentage |
|---|---|---|
| NO DEFICIT | 4 | 9.3% |
| PARAPARESIS | 2 | 4.7% |
| PARAPLEGIA | 4 | 9.3% |
| QUADRIPARESIS | 7 | 16.3% |
| QUADRIPLEGIA | 26 | 60.5% |
| Total | 43 | 100.0% |

In our study, of 43 patients, 26(60.5%) patients had quadriplegia, 7 (16.3%) patients had quadriparesis, 4(9.3%) had paraplegia, and 2 (4.7%) had paraparesis and 4 (9.3%) patients did not have any neurological deficit.

FIGURE 15: BAR DIAGRAM SHOWING NEUROLOGICAL DEFICIT

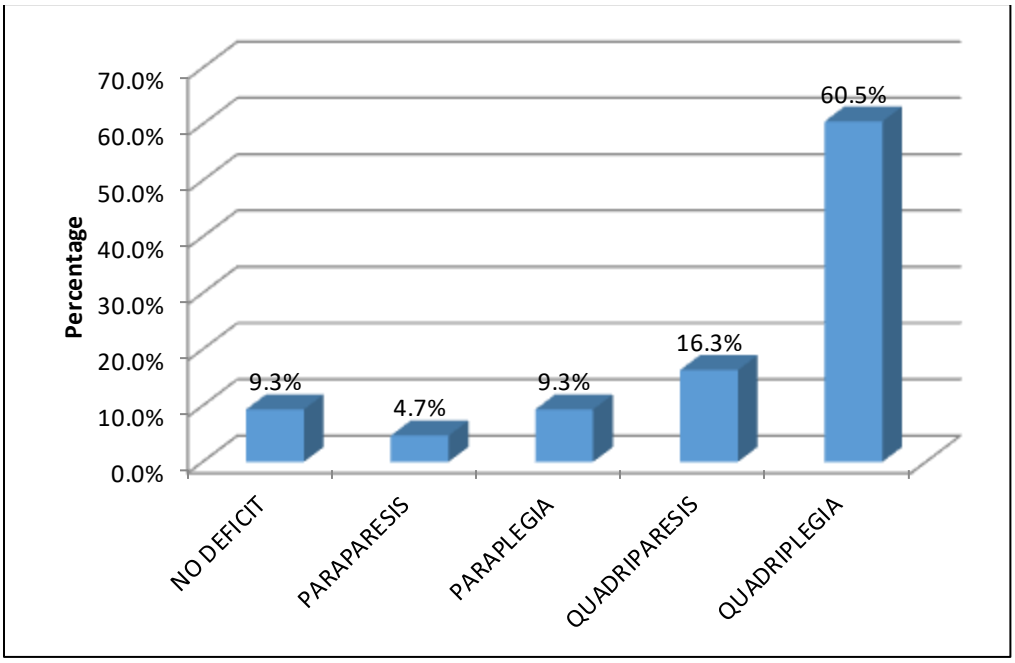


TABLE 16: TABLE SHOWING ASSOCIATED INJURIES

| ASSOCIATED INJURY | FREQUENCY | PERCENT |
|---|---|---|
| ISOLATED SPINE INJURY | 30 | 69.7 |
| HEAD INJURY | 4 | 9.3 |
| CHEST | 3 | 6.9 |
| ABDOMEN | 2 | 4.6 |
| LONG BONE | 3 | 6.9 |
| ELECTRIC BURN | 1 | 2.3 |

In our study, about 69.7% (N=30) of patients had isolated spine trauma. Head injury was most common [9.3%(N=4) of cases] associated injury seen in our study, followed by chest and long bones (6.9% of cases each), abdomen injury in 4.6% and electric burn in 2.3% of patients.

FIGURE 16: BAR DIAGRAM SHOWING THE ASSOCIATED INJURIES

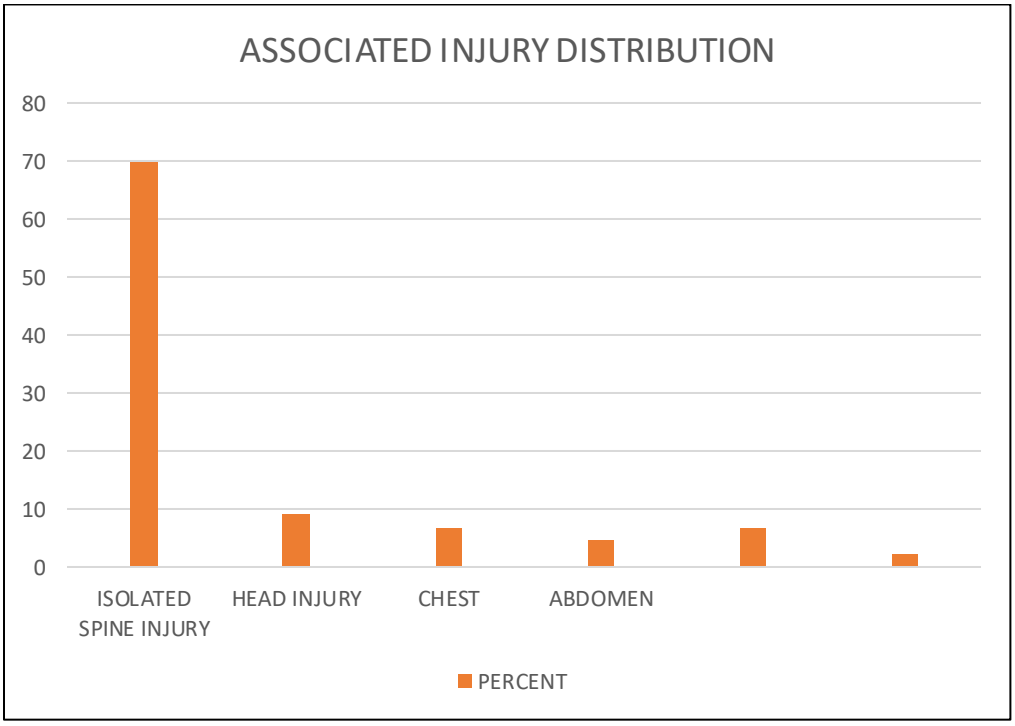


TABLE 17: TABLE SHOWING THE MRI FINDING IN SPINE INJURY

| MRI FINDING OF SPINAL CORD | FREQUENCY | PERCENT |
|---|---|---|
| CORD CONTUSION | 20 | 46.5 |
| CORD COMPRESSION | 9 | 20.9 |
| CORD TRANSECTION | 2 | 4.6 |
| CORD COMPRESSION + CONTUSION | 6 | 13.9 |
| NO SPINAL CORD INJURY | 6 | 13.9 |

In our sturdy, about 13.9% of the spine injury patients had normal spinal cord finding in MRI, however about 46.5% (N=20) of them had cord contusion, 20.9% (N=9) had cord compression, 4.6% (N=2) of cases had cord transection, 13.9 % (N=6) had cord compression along with contusion

FIGURE 17: BAR DIAGRAM SHOWING THE MRI FINDING IN SPINE INJURY

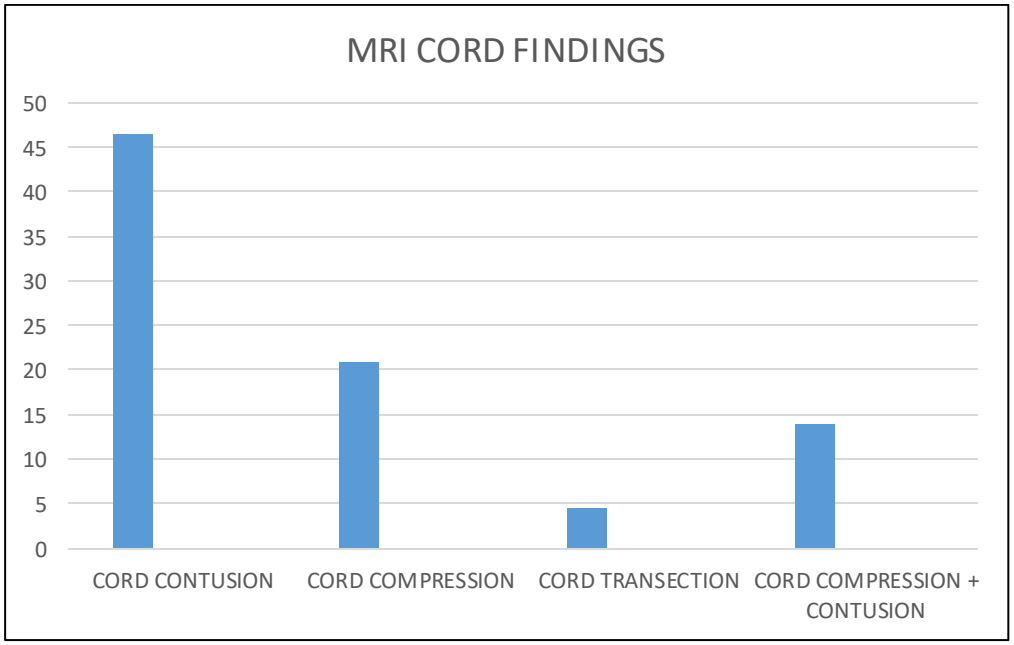


TABLE 18: TABLE SHOWING ASSOCIATED MEDICAL CONDITIONS OF SPINE INJURY PATIENTS

| **ASSOCIATED COMORBID CONDITIONS** | No. of cases | Percentage |
|---|---|---|
| ANKYLOSING SPONDYLOSIS | 1 | 2.3% |
| DIABETES | 4 | 9.3% |
| HYPERTENSION | 5 | 11.6% |
| NONE | 29 | 67.4% |
| SEPTIC SHOCK | 3 | 7.0% |
| SPINAL SHOCK | 1 | 2.3% |
| Total | 43 | 100.0% |

In our study of 43 patients, about 67.4% had no associated co morbid conditions, while 11.6% of them had hypertension, 9.3% of them had diabetes, 7.0% of them had septic shock and 2.3% of them had spinal shock and 2.3 % of them had ankylosing spondylosis .

FIGURE 18: BAR DIAGRAM SHOWING ASSOCIATED MEDICAL CONDITIONS

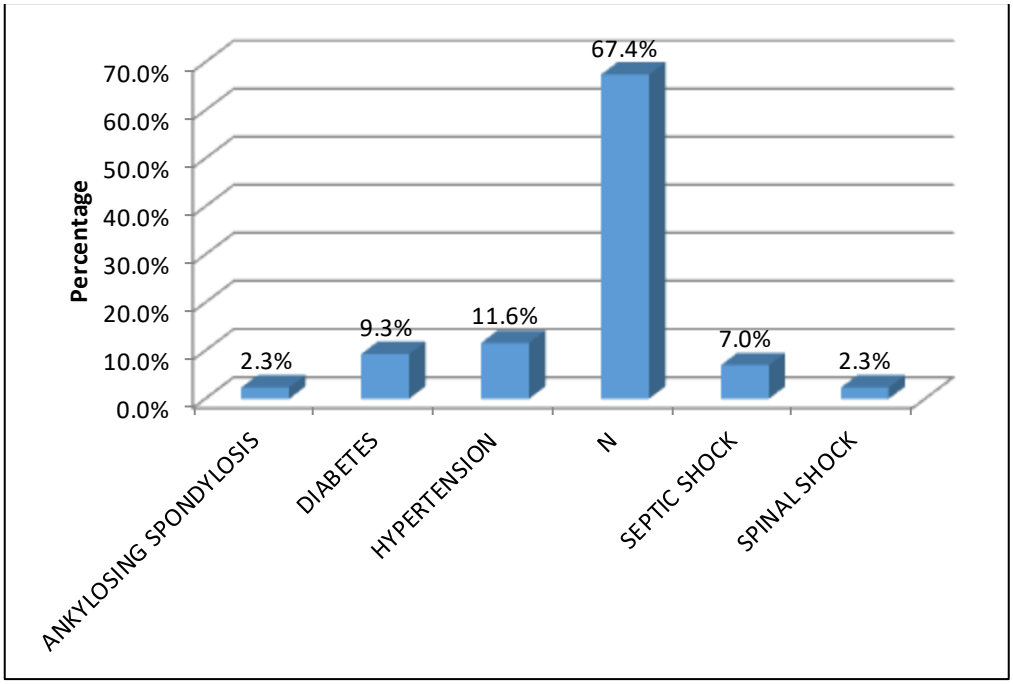


TABLE 19: TABLE SHOWING THE MANAGEMENT OF SPINE INJURY

| **MANAGEMENT** | No. of cases | Percentage |
|---|---|---|
| CONSERVATIVE MANAGEMENT | 25 | 58.1% |
| SURGERY | 18 | 41.9% |
| Total | 43 | 100.0% |

In our study, about 41.9 % (N= 18) of patients underwent surgical intervention while 58.1% (N=25) of them were managed conservatively.

FIGURE 19: PIE DIAGRAM SHOWING THE MANAGEMENT OF SPINE INJURY

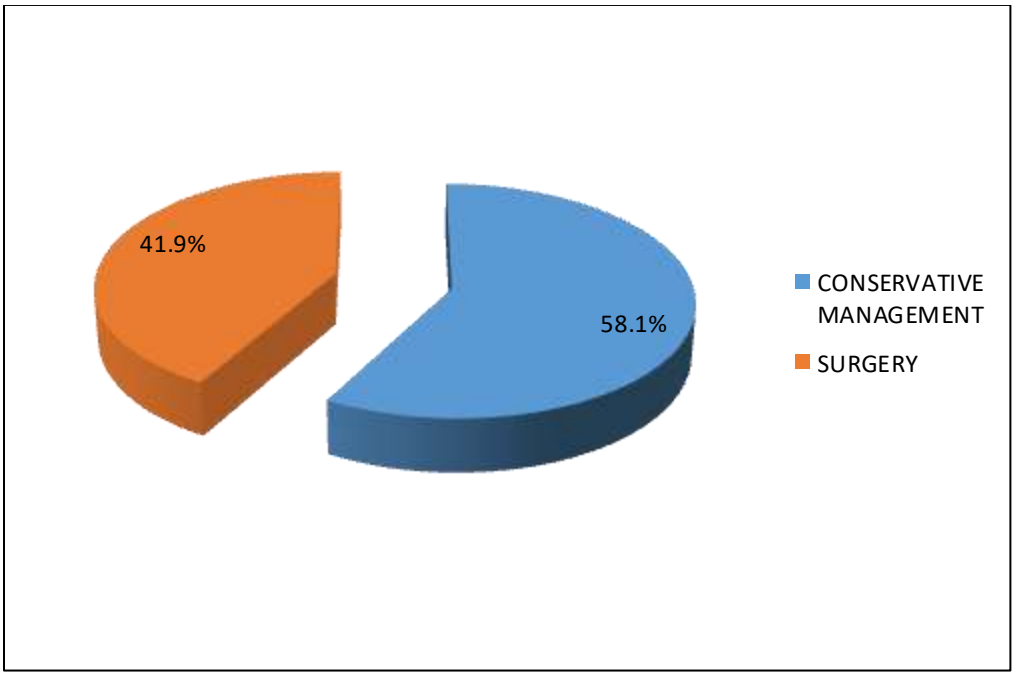


TABLE 20: TABLE SHOWING THE CONSERVATIVE MANAGEMENT OF SPINE INJURY

| TYPE OF MANAGEMENT | FREQUENCY | PERCENT |
|---|---|---|
| NO INDICATION FOR SURGERY | 18 | 72% |
| DIED BEFORE SURGERY | 2 | 8% |
| NO CONSENT FOR SURGERY | 5 | 20% |

In our study, among 25 (58.1%) patients who underwent conservative management, about 18 patients had no indication for surgery, 2 patients died before surgery and 5 patients didn't give consent for surgery

FIGURE 20: BAR DIAGRAM SHOWING CONSERVATIVE MANAGEMENT

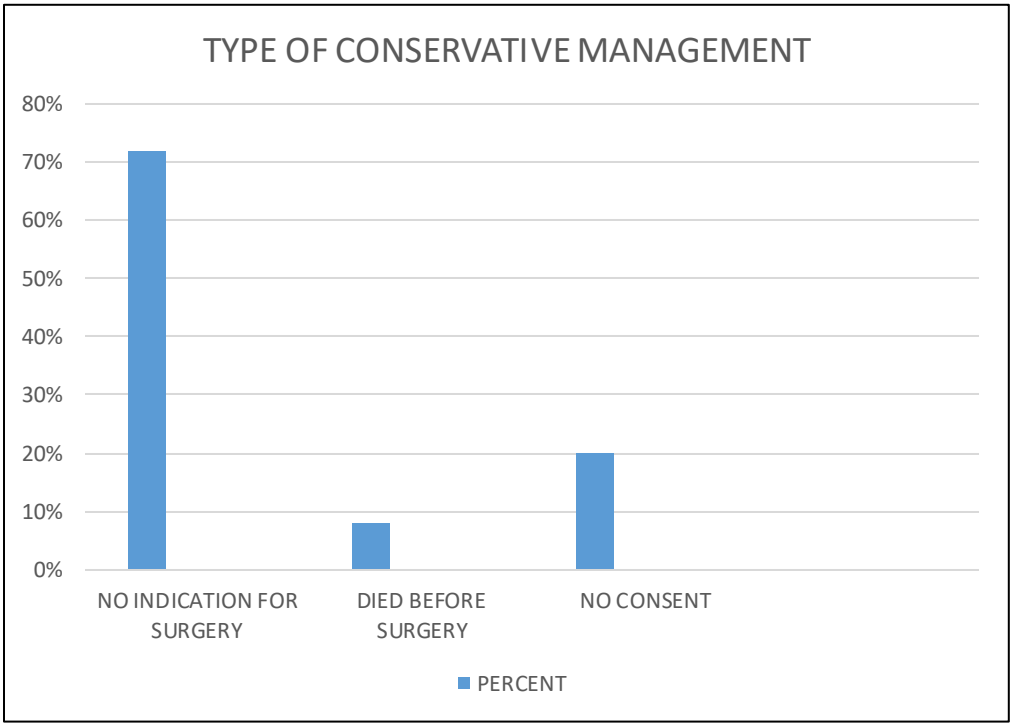


TABLE 21: TABLE SHOWING THE SURGICALLY MANAGED LEVEL OF SPINAL INJURY

| LEVEL OF INJURY | FREQUENCY | PERCENT |
|---|---|---|
| CERVICAL | 11 | 61.1 |
| THORACIC | 3 | 16.6 |
| LUMBAR | 3 | 16.6 |
| SACRAL | 0 | 0 |
| CERVICO-THORACIC | 1 | 5.5 |
| THORACOLUMBAR | 1 | 5.5 |

In our study, about 41.9% (N=18) of cases were managed surgically. Out of which, about 61.1% of them were performed in cervical region followed by 16.6 % each in thoracic and lumbar regions and 5.5% of each in cervico-thoracic and thoracolumbar regions. Those patients who underwent surgical intervention for cervical spine injury underwent anterior cervical discectomy and fusion and those with dorsal and lumbar spine injury underwent decompression and transpedicle screw fixation.

FIGURE 21: PIE DIAGRAM SHOWING THE SURGICALLY MANAGED LEVEL OF SPINE INJURY:

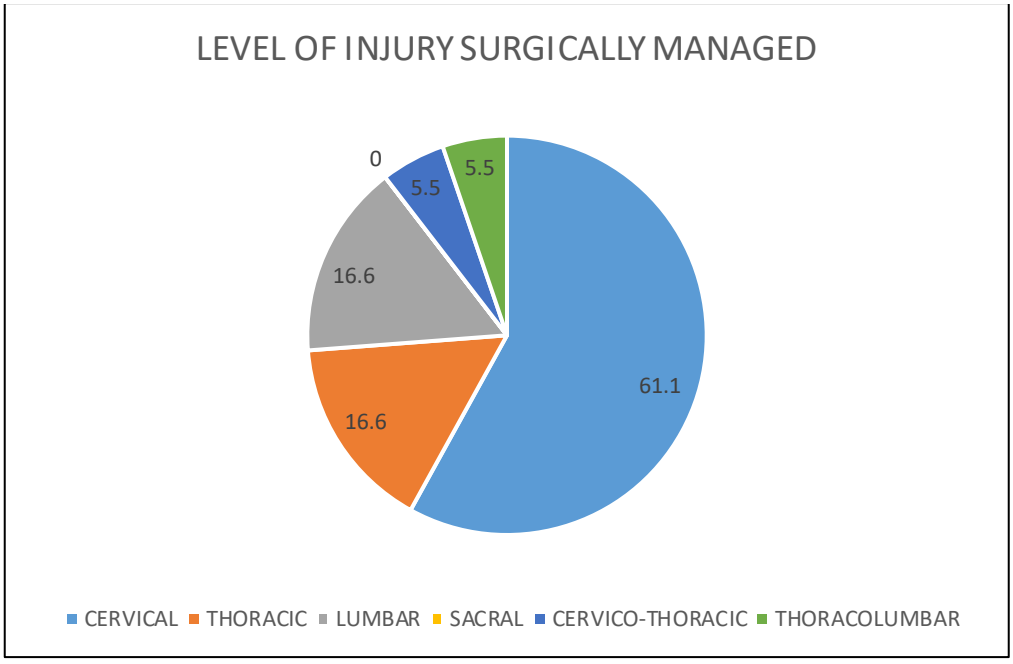


TABLE 22: TABLE SHOWING DURATION OF HOSPITAL STAY

| DAYS | FREQUENCY | PERCENT |
|---|---|---|
| <10 DAYS | 12 | 27.9 |
| 10-19 DAYS | 15 | 34.8 |
| 20-29 DAYS | 6 | 13.9 |
| >30 DAYS | 10 | 23.2 |

In our study, 34.8% (N=15) of patients had hospital stay between 10-19 days followed by 27.9% (N=12) stayed for less than 10 days, 23.2% (N=10) stayed for more than 30 days and 13.9% (N=6) of patients had hospital stay of 20-29 days with a mean stay of 17.62 and standard deviation of 10.72

FIGURE 22: BAR DIAGRAM SHOWING DURATION OF HOSPITAL STAY

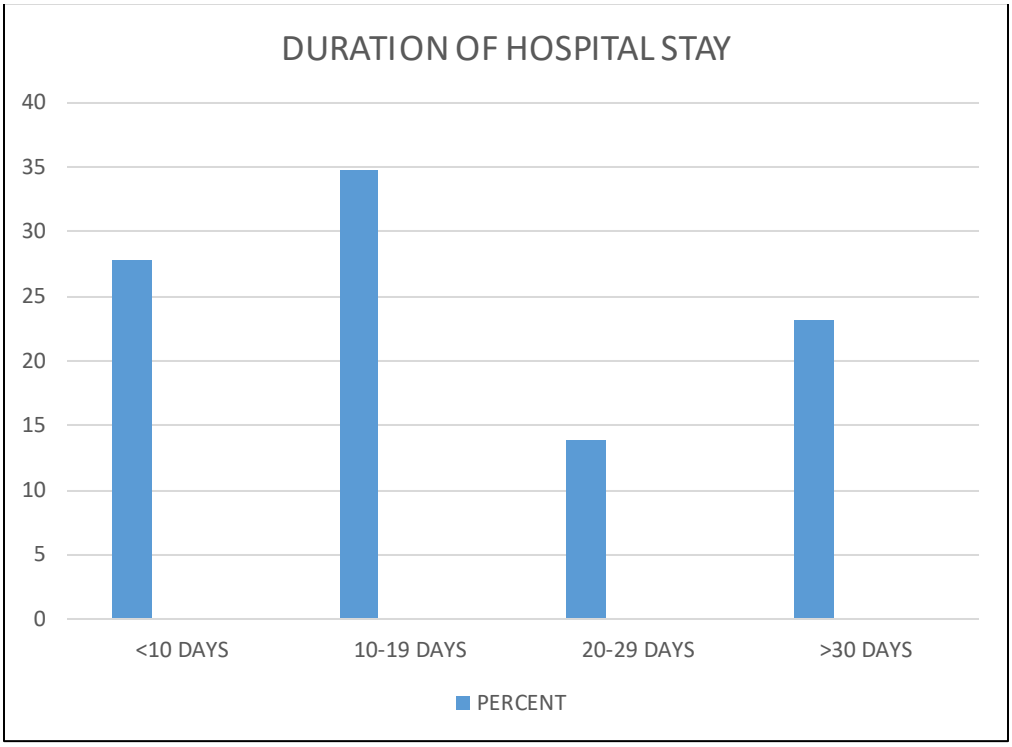
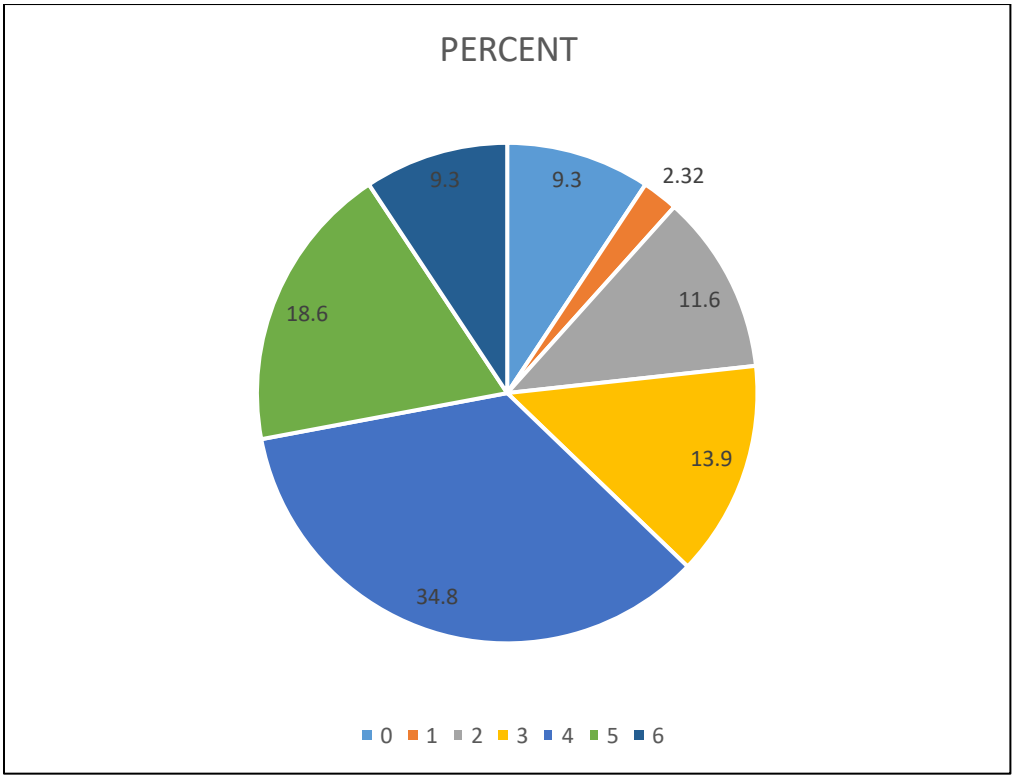


TABLE 23: TABLE SHOWING MRS SCORE ON FOLLOW UP

| MRS score | FREQUENCY | PERCENT |
|---|---|---|
| 0 | 4 | 9.3 |
| 1 | 1 | 2.32 |
| 2 | 5 | 11.6 |
| 3 | 6 | 13.9 |
| 4 | 15 | 34.8 |
| 5 | 8 | 18.6 |
| 6 | 4 | 9.3 |

In our study, about 34.8% of patients had MRS score of 4 , followed by 18.6% of patients with score of 5, 13.9% of patients with score 3,11.6% of patients with score of 2, 9.3% with score of 6 and 0 each, 2.32 % of them with score of 1.

FIGURE 23: PIE DIAGRAM SHOWING MRS SCORE ON FOLLOW UP



# DISCUSSION

This study was conducted in the department of neurosurgery DMCH Ludhiana over a period of one year. About 43 patients of all age groups with spinal injuries were included in the study.

Majority of patients in our study were male compared to female (79.1% versus 20.9% of patients) with male to female ratio of 2.7:1, this coordinates with other studies in the literature. In Karammehmetoglu SS et al study the male to female ratio was 3:1.[52] Pickett W et al in their study reported the male to female ratio in the age groups from 10 to 69 years range 2.2 to 3.5:1[56]. Calancie B et al reported about 76.4% of spine injuries in males which is similar to our study in which 79.1% of spine injuries were seen in males[57]. Lofvenmark et al reported about 71% of spine injuries in male [61]. Thus male to female ratio in our study is similar to previous studies in the literature.

In our study, age groups ranged from 18 to 87 years with the mean age of 44.5 years. About 34.9% of spine injuries were seen in the age group less than 30 years followed by 23.3% of cases in 41 to 50 years group. This is similar to previous studies in literature. Calancie B et al reported the average age of spine injury as 39.8 +/- 16.8 years[57]. Chhabra et al, Thomson C et al, Anadalib S et al in their study reported that the mean age of spine injury as 34 years, 39.1+/-15.9 years and 42.7+/-16.8 years respectively. The age group in our study is similar to previous studies in the literature.[68-70]

In our study majority of the spine injuries were seen in people who were students (32.5% of patients), followed by farmers (27.9% of patients), businessman and homemakers which accounted for 13.9% of patients each and then dependents (5% of patients). Chhabra HS et al reported that most of the spinal injuries were seen in non-professional job (18.02% of cases) followed by professional private jobs (17.26%), students (12.26%), labourers (8.04% of cases)[71]. Mathur et al reported that about 23.3% and 22.9% of spinal injuries were seen in farmers and labourers respectively[62]. Liu J found that

most common occupation of patients with spinal cord injury as workers (28.6%) followed by office clerk (16.8% of cases)[66].

In our study most of the injuries were observed to have happened during 6:00 PM to 12:00 PM (48.3% of cases) followed by 12:00 PM to 6:00PM (34.8%), then during morning hours 6:00 AM to 12:00 PM (9.3%) and 12:00 AM to 6:00 AM (6.9% of cases). No literature is available to compare our study with previous literature.

In our study, Most of the spine injuries happened during winter season which accounted for 44.1% (N=19). About 23.2%, 20.9%, 13.9% of spine injuries were seen in seasons of summer, autumn and spring respectively. In our study, most of the injuries happened in winter season because of low visibility leading to high incidence of road traffic accidents. Chhabra and et al reported that most injuries were seen in the month of May and June. Johnson et al found that incidents of spine injury were higher during summer and autumn months[67,68]. Other previous literature reported that most of the injuries occurred during summer season due to increased travelling activities during summer time.

In our study road traffic accident was the most common cause of spine trauma which accounted for 65.1% of cases, followed by fall history which accounted for 34.8% of them. Among patients with history of fall, fall from Stairs and in bathroom accounted for 33% of them, and fall from balcony was the second most common cause in patients with history of fall which accounted for 26.6% and fall from electric pole accounted for 6.6% of them. when compared with previous literature, some literature reported that road traffic accident was the most common cause followed by fall history whereas in some other literature it was contradictory with history of fall as most common cause followed by road traffic accident. Mathur et al reported that fall from heights (53% of them) was most common cause followed by road traffic accidents (28%)[62]. Joseph Mittal reported that most common cause of spinal injury was fall (58%) followed by transport related events (40%) respectively[64]. Liu J et al reported that RTA the most common cause and history of fall the second most common mode of

injury[66]. This observation is similar to that of most other studies from developed countries but in contrast Indian studies show that fall is the most common mode of injury.

Most of the spine injuries caused due to a RSA, presented to our institute were most commonly caused by accidents involving light vehicles which accounted for 60.8% of cases followed by accidents involving 2 Wheelers which accounted for 39.2% of cases. Most of the accidents happened in secondary type of roads i.e., state highways rather than the national highways. Lofvenmark et al reported that the main cause of traumatic spine injury was RSA followed by assault and fall [61]. Chhabra et al reported that RTA was the most common cause and fall the second most common mode of injury[68]. This observation is similar to that of most other studies from developed countries but in contrast to other Indian studies in which fall is the most common mode of injury.

Few studies also revealed that major cause of traumatic spine injury in North America, Western Europe and Australian regions involved 4 wheeled motor vehicle accidents. Chhabra et al series reported RTA on highway roads in 39.5% of the cases[68]. In our study spine injuries due to RSA occurred mostly due to reckless driving accompanied by poor condition of the road, alcohol consumption and drug intoxication. About 58.1% of patients who presented with spine injury in our institute had ASIA grade A at the time of admission, followed by 14%, 9.3 %, 4.7% of cases with ASIA grade D, E, B&C respectively. In 4 patients (9.3%) ASIA grading couldnot be determined at the time of admission due to poor GCS. Derakhshanrad N et al. reported that most common neurological type of injury was ASIA grade A (53.5%) followed by 18.7%, 17.6%, 9.6% and 0.6% as ASIA grade B,C,D,E respectively[63]. Halovorsen A et al also reported that most common injury at the time of admission was complete injury ASIA grade A which was seen in 77% of cases [65]. Rahimi Movaghar V et al reported the complete injury was more common than incomplete injury (complete SCI 56.5%, incomplete SCI 43% of cases)[71].

In our study about 79% of spine injuries occurred in cervical region followed by 9.3% (N= 4), 7% (N=3), 4.7% (N= 2) of them in dorsal region, lumbar region, cervico-thoracic region respectively. In previous literature. Roche SJ et al. reported that 42.6%, 14.29%, 7.14%, 28.57% of spinal injuries were cervical, thoracic, lumbar and sacral spine injuries[58]. Hagen et al also reported that most of the spine injuries were seen in cervical and thoracic region which accounted for 52.4% and 29.5% respectively[59]. Liu J et al also reported that 54% of their patients had cervical injuries. In our study most of the spine injuries were seen in cervical region.

Calenoff L et al reported that, of the 43 patients studied, 2 patients sustained injuries at 2 level (4.6% of cases) and 1 patient showed fracture at more than 3 levels (2.3% of cases)[57]. Mortazavi MM et al reported that the incidence of multi levels final involvement reported in literature ranges from 6% to 50% in children. In their study 48(26.2%) patients had injuries involving more than one segment of the spine. In our study about 93%(N=40) of patients presented with single level fracture followed by 4.6% and 2.3% of patients had 2 level and more than 3 level fractures respectively.

In our study, the most common type of fractures were burst fractures which accounted for 39.5% of cases followed by 32.5% (N=17), 16.25%(N=14), 4.6%, 2.3% of cases with subluxation, wedge fracture, spinous process and hangman fracture respectively. Roche SJ et al reported that in 285 patients there were a total of 380 injuries to the vertebral column consisting of 366 fractures, 8 subluxation, 2 fracture-subluxations and 1 dislocation. Andalib S et al reported that most common fractures seen in cervical spine were translational injury (19.4% of cases), compression fracture (10.4%), whereas in thoracic regions most common fractures seen were burst fractures (62.7% of cases), wedge fractures (21.3% of cases) and in lumbar regions most common fractures seen were burst fractures (75.4% of cases), locked facet was seen in 4.4%[70].

In our study about 86.1% of patients had cord abnormalities, 13.9% of them had normal MRI, 46% patients with spine injury had

cord contusion. 29.5 % of patients had cord compression, 13.9% had cord compression along with contusion and 4.6% of patients had cord transections. Parashar UC et al, MRI examination revealed that cord abnormalities were present in 47 out of 62 patients i.e, 75.8% of the patients, in 26.32% no abnormality was noted in cord[37]. Kulkarni MV et al revealed presence of cord abnormalities in 70% patients and skeletal abnormalities in 78% of patients[41].

In our study about 41.9% of patients underwent surgery while 58.1% were managed conservatively. In patients who were managed surgically, about 61.1% of them had spinal injury in cervical region followed by 16.6% in thoracic and lumbar region each, 5.5% of cases in cervicothoracic and thoracolumbar regions each. In patients who were managed conservatively about 72% of them had no indication for surgery, 8% died before surgery and 20% of them did not give consent for surgery. Wang ZM et al in their study reported that 2763 (79.24%) received surgical treatment and 724 (20.76%) received conservative treatment[72]. Michelle J et al index study over the last 10 years reported surgical rate was seen in 77% of the patient switch spine injury[73]. Pandey VK et al index study showed that 17 patients were given injection Solumedrol with conservative treatment, 35(60%) patients were given only conservative treatment and 7(11.66%) patients were operated[74]. In our study, the surgical rate was similar to the previous study in literature.

In our study 34.8% (N=15) of patients had hospital stay between 10-19 days followed by 27.9% (N=12) stayed for less than 10 days, 23.2% (N=10) stayed for more than 30 days and 13.9% (N=6) patients had hospital stay of 20-29 days with a mean stay of 17.62 days and standard deviation of 10.72. Wang HF et al reported that mean hospital stay in patients with traumatic spinal cord injury was 17 days (range 1 to 80 days)[75]. Wank ZM et al also reported that duration of hospitalisation in patients with spinal cord injury ranged from 1 to 375 days with an average of 17.5 days[72]. Singh R et al. reported that average hospital stay in their study was 39.5 days (range 7 to 93 days)

thus the duration of our study is similar to previous study in the literature.

In our study about 69.7% (N=30) of patients had isolated spine trauma. Head injury was most common [9.3% (N=4) of patients] associated injury seen in our study, followed by chest and long bone (6.9% of cases) each, abdomen injury in 4.6% and electric burn in 2.3% of patients. Chhabra HS et al showed that out of other injuries associated spinal injuries, orthopedic injuries were commonest (23.18%) injuries, followed by chest injuries (11.07%), head injuries (5.548%) and other spine fractures (2.94% of cases)[68]. Wang ZM et al reported that injuries associated with spine trauma included craniocerebral injury (11.09%), frontfacial injury (22.79%), chest,/abdominal injuries (20.1%), pelvic injuries (14.4%) and limb fractures (31.8% of cases)[72]. Mathur N et al. reported in their studies that extremity and rib fractures (10.6%) and head injuries (7.2% of cases) were common associated injuries[62].

In our study the complications that occurred during hospital stay included requirement of tracheostomy, sepsis. Santos EAS et al reported that medical complications were observed in 45% of the patients, Pneumonia being the most frequent one. Other complications included pressure ulcers in 3.7% of cases, urinary tract infections in 2.3% of cases, deep venous thrombosis in 3.2%, wound infections and others 34% of cases. Wang ZM et al reported that during hospitalization, a total of 1341 patients experienced complications with the percentage of 38.4%. Among all complications pulmonary infection was the most common 32.5% of cases, followed by hyponatremia 24.3% of cases, bedsore 16.3% of cases, urinary tract infection 12.5% of cases, deep venous thrombosis 11.7% of cases and others 2.53% of cases[72]. Mu Z et al reported that out of total 294 of patients with cervical spine injury 52% of them received tracheostomy. In our study also most of the patients who underwent tracheostomy suffered from cervical spine injuries.

In our study, on follow up about 34% of patients had MRS score of 4, followed by 18.6% of patients with score of 5, 13.9% of patients

with score 3,11.6% of patients with score of 2, 9.3% with score of 6 and 0 each, 2.32 % of patients with score of 1. No studies were available in the literature to compare where MRS is used to compare in spinal injuries. In our study, among the patients who died, all 4 had cervical spine injury. No death was seen in patients with dorsal or lumbosacral fractures. Among the causes of death, respiratory failure and sepsis were major causes.

In our study, mortality rate was seen in 9.3% of cases and among who died all of them had cervical spine injuries. No death was seen in dorsal, lumbar, sacral fractures. Shock, sepsis and respiratory failure were observed as causes of death. The patients who died were managed conservatively. Calancie B et al. reported that 17 of their patients died during the 3 years follow up. Many of them were dependent on ventilator from the time of injury and later developed pulmonary insufficiency. 3 subjects died of pulmonary embolism and GI bleeding[57]. Feng HY et al. eight patients died after operation, 7 had cervical spine injury and 1 patient with lower dorsal fracture, in the end 4 patients died because of respiratory failure, 2 died from acute pulmonary embolism and 2 died due to multi-organ failure. Kang Y et al estimations of spinal cord injury among developed nations varied from 3.1 to 22.2% while mortality in underdeveloped nations ranged from 1.4 to 20%. In our study the mortality rate was similar to previous literature[8].

# SUMMARY AND CONCLUSIONS

1. Spine trauma was more common in males than females with male to female ratio 3.7:1.
2. The range of age of patients suffering spine trauma was 18 years to 87 years with mean age being 44.5 years.
3. Majority of spine injuries were seen in students (32.5% of cases), aged less than 30 years.
4. Most of the spine trauma cases were seen during 6PM TO 12 AM which accounted to 48.3% of cases.
5. Most of the spine injuries occurred during winter season which accounted for 44.1% of cases, due to low visibility leading to high risk of road traffic accidents.
6. The most common cause of spine injury was road traffic accidents and accounted for 65.1% of cases.
7. Most of the spine injuries due to RSA were caused by 4 wheeler light motor vehicle accounting to 60.8% of cases.
8. Most of spine injuries due to fall were domestic fall from stairs/ in bathroom which accounted for 33% each.
9. Most of the patients with spine injury presented to our institute were within GCS 13-15 which accounted for 76.7% of cases.
10. Most common ASIA scale at the time of admission was GRADE A which accounted for 58.1% of cases.
11. Most common level of spine injury in our study was seen in cervical region (79% of cases) followed by thoracic region (9.3% of cases)
12. In our study about 93% of patients had single level of fracture followed by 2 level fracture in 4.6% and 2.3% of cases had more than 3 levels of fracture.
13. The most common type of fracture was burst fracture (39.5% of cases) followed by subluxation fractures (32.5% of cases).
14. Most common MRI finding in our study was cord contusion (46.5% of cases) followed by cord compression (20.5% of cases).
15. In our study about 41.9% of patients underwent surgery and 58.9% of them were managed conservatively.

16. In patients who were managed conservatively 61% of injuries were seen in cervical region.
17. In conservatively managed patients, 72% didnot have indication for surgery, 8% died before surgery and 20% of them didnot give consent for surgery.
18. In patients who were surgically managed about 61.1% of them had injury in cervical region and they underwent anterior cervical discectomy and fusion (ACDF/ACCF) and those with dorsal and lumbar spine injury underwent decompression and transpedicle screw fixation.
19. The mean duration of hospital stay was 17.62 days and standard deviation of 10.72.
20. The most common associated injury was head injury in 9.3% of cases followed by chest and long bones injuries with 6.9% of cases each.
21. In our study, about 34% of patients had an MRS score of 4, followed by 18.6% of patients with score of 5, 13.9% of patients with score 3,11.6% of patients with score of 2, 9.3% each with score of 6 and 0 , 2.32 % of them with score of 1.
22. Mortality rate in our study was 9.3% of cases and the patients who died had cervical spine injury and its complications
23. Most common cause of death in our study was sepsis (4.6% of cases) followed by respiratory failure and shock.(2.3% of cases each).

International spinal cord society (ISCoS) has decided to observe spinal cord injury day on 6th September every year with the intention of increasing awareness among the general public. According to the observation and results from our study the most common cause of spine injury was road traffic accidents. Wearing protective headgear, seat belts while driving is highly recommended, improving road conditions, increasing de-addiction clinics and avoiding the low visibility conditions or foggy conditions while driving is recommended to prevent head and spine injuries. Fall from height was another important cause of spinal injury.

In our region and country as a whole, the emergency services in primary healthcare centres provided to patients with spine trauma is not up to the mark. Teaching and awareness programs to healthcare workers regarding primary care of patient who sustains spine trauma is very important step that is much needed. Knowledge of how to transport patient who sustained spine injury is very important regarding airway management in cervical trauma, immobilization of neck, use of spine board while transporting suspected spine trauma patient, dose of Methylprednisolone are some of the very crucial steps initially and determines the final outcome of patients.

On reaching well equipped medical center decision regarding surgical or non-surgical medical assistance needs to be taken. For those patients who require surgery, early decision is always recommended even though its role in determining the outcome of patient is controversial once the spinal shock or associated acute conditions are resolved. Post-surgery or in those patients who are quadriplegic or paraplegic aggressive nursing care and physiotherapy is recommended to prevent complications like bedsores, pneumonia and DVT. Lastly, as most of the patients are quadriplegic or paraplegic and usually they become dependent on the family members for rest of their life, so aggressive rehabilitation, encouragement and family support is crucial and play significant role in their life.

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PICTURE 4:

A)

4(A): X RAY SHOWING FRACTURE LISTHESIS OF C4/5 CERVICAL SPINE

B)

4(B): SAGITTAL SECTION OF NCCT CERVICAL SPINE WITH C6/7 LISTHESIS

C)

4(C):SAGITTAL SECTION SHOWING MRI OF CERVICAL SPINE INJURY ALONG WITH SPINAL CORD INURY

D)

4(D): TRANSVERSE SECTION OF CERVICAL SPINE WITH BURST FRACTURE AT C6/7 LEVEL

PICTURE 5:

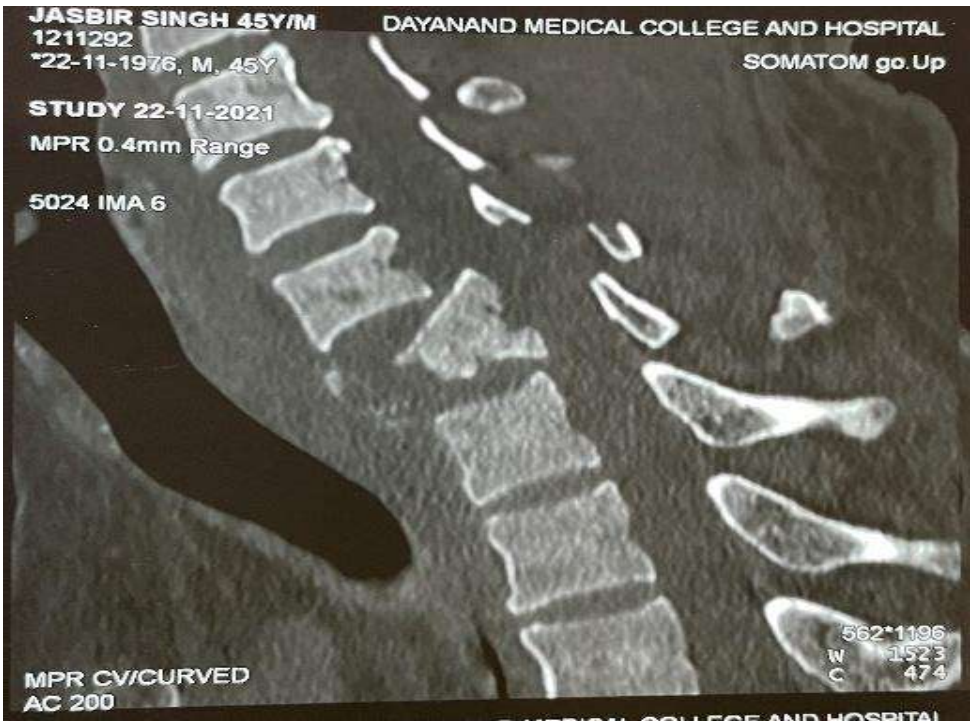
A)

5(A): X RAY SHOWING POST OP ACDF OF CERVICAL SPINE INJURY

B)

5(B): SAGITTAL SECTION MRI CERVICAL SPINE WITH C6/7 LISTHEIS WITH CORD INJURY

(C)




5(C): X RAY SHOWING LATERAL VIEW OF C SPINE INJURY WITH C6/7 LISTHESIS AND BURST FRACTURE OF C6

PICTURE 6:

A)

6(A): SAGITTAL SECTION OF WHOLE SPINE SHOWING THE COMPRESSIVE MYELOPATHY OF CERVICAL SPINE WITH PROLAPSED D11/12 DISC WITH CORD COMPRESSION

B)

6(B): X RAY CERVICAL SPINE WITH ANKYLOSING SPONDYLOSIS WITH FRACTURE OF C6 VERTEBRA

(C)

6(C): X RAY LATERAL VIEW SHOWING POST OP C5/6 FIXATION

(D)

6(D): SAGITTAL CUT OF CT SHOWING ANKYLOSING SPONDYLOSIS WITH C5/C6 FRACTURE

PICTURE 7:

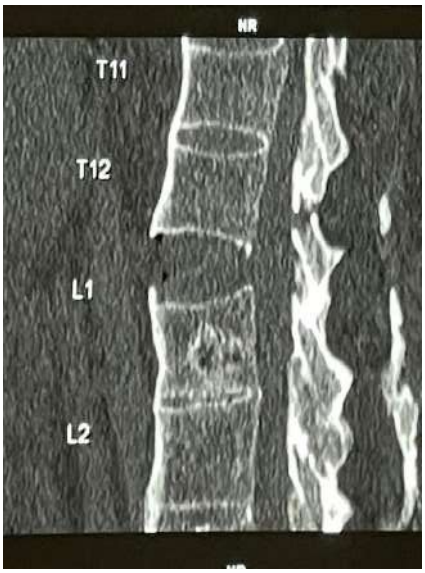
A)

7(A): X RAY CERVICAL SPINE LATERAL VIEW WITH C2/3 LISTHESIS

B)

7(B): TRANVERSE SECTION OF C2 WITH FRACTURE

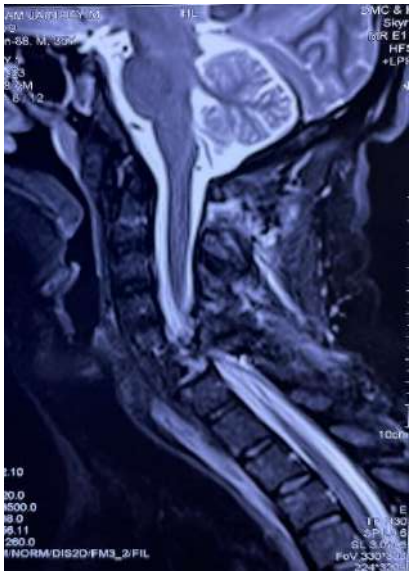
C)




7(C): SAGITTAL SECTION OF CT OF DORSOLUMBAR SPINE WITH FRACTURE D12/L1

PICTURE 8:

A)



8(A): SAGITAL SECTION O F CT SHOWING CERVICAL SPINE INJURY WITH CORD TRANSECTION AT C4/5 LEVEL

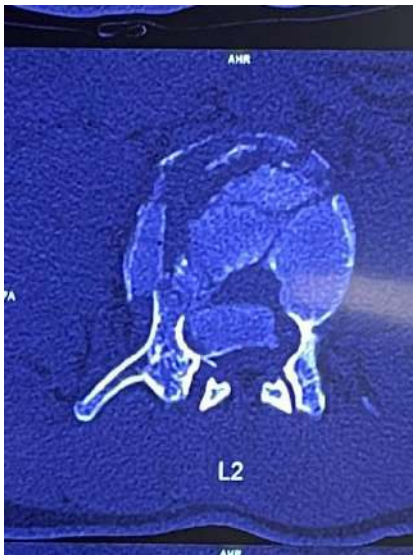
B)

8(B): SAGITTAL SECTION OF MRI WITH FRACTURE L2 WITH SPINAL CANAL DISTURPTION

C)

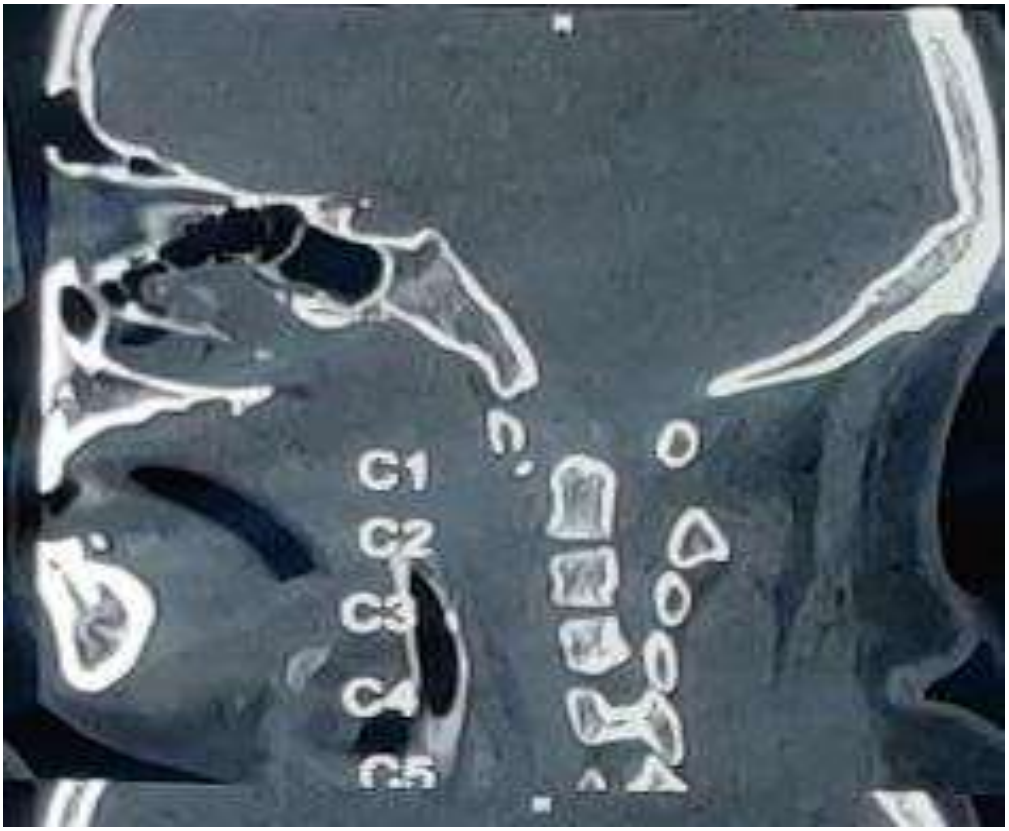
8(C): SAGITTAL SECTION OF CT CUTS OF L2 FRACTURE

D)




8(D): AXIAL SECTION OF CT CUTS OF L2 FRACTURE

PICTURE 9:




SAGITTAL SECTION OF CT SHOWING FRACTURE OF C1 AND DISRUPTION AT THE LEVEL OF C1/2 LEVEL

| S No. | MRD | INITIALS | AGE | SEX | OCCUPATION | MODE OF INJURY | WHEELER/FALL | DATE OF INJURY | TIME OF INJURY | SEASON | DATE OF ADMISSION | DATE OF DISCHARGE | DURATION OF HOSPITAL STAY | GCS | GCS GROUP | TRACHEOSTOMY | ASSOCIATED INJURY | ASSOCIATED COMORBID CONDITIONS | NEUROLOGICAL DEFICIT | SHOULDER | ELBOW | WRIST |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 471040 | JS | 55 | MALE | FARMER | RSA | 2 | 05/09/2021 | 9:00 PM | SUMMER | 05/09/2021 | 19/09/2021 | 14 DAYS | 15 | 3 | N | NONE | ANKYLOSING SPONDYLOSIS | QUADRIPLEGIA | 2 | 2 | 1 |
| 2 | 1172834 | LS | 72 | MALE | DEPENDENT | RSA | 4 | 13/09/2021 | 4:00 PM | AUTUMN | 14/09/2021 | 23/09/2021 | 9 DAYS | 15 | 3 | N | NONE | HYPERTENSION | NO DEFICIT | 5 | 5 | 5 |
| 3 | 1136820 | C | 45 | MALE | FARMER | FALL FROM HEIGHT | balcony | 14/09/2021 | 10:30 AM | SUMMER | 14/09/2021 | 17/09/2021 | 33 DAYS | 15 | 3 | N | NONE | N | QUADRIPLEGIA | 3 | 3 | 3 |
| 4 | 1185399 | HK | 30 | FEMALE | HOMEMAKER | RSA | 4 | 03/10/2021 | 10:00 PM | AUTUMN | 04/10/2021 | 20/10/2021 | 16 DAYS | 15 | 3 | N | NONE | N | QUADRIPLEGIA | 3 | 2 | 1 |
| 5 | 1192629 | RR | 35 | FEMALE | HOMEMAKER | DOMESTIC FALL | bathroom | 18/10/2021 | 6:30 PM | AUTUMN | 18/10/2021 | 31/10/2021 | 13 DAYS | 15 | 3 | N | LIVER INJURY | N | QUADRIPLEGIA | 2 | 0 | 0 |
| 6 | 1207614 | MK | 45 | FEMALE | HOMEMAKER | RSA | 4 | 14/11/2021 | 8:00 PM | AUTUMN | 14/11/2021 | 22/12/2021 | 38 DAYS | 10 | 2 | Y | NONE | SEPTIC SHOCK | QUADRIPLEGIA | 1 | 1 | 0 |
| 7 | 1211912 | SS | 60 | MALE | FARMER | FALL FROM HEIGHT | stairs | 21/11/2021 | 8:00 PM | WINTER | 22/11/2021 | 22/12/2021 | 30 DAYS | 10 | 2 | Y | NONE | N | QUADRIPLEGIA | 3 | 3 | 2 |
| 8 | 1212615 | PS | 40 | MALE | BUSINESS | RSA | 4 | 22/11/2021 | 7:30 PM | AUTUMN | 23/11/2021 | 06/12/2021 | 13 DAYS | 15 | 3 | N | NONE | N | QUADRIPARESIS | 3 | 2 | 2 |
| 9 | 1211292 | JS | 45 | MALE | FARMER | FALL FROM HEIGHT | stairs | 22/11/2021 | 9:00 PM | AUTUMN | 22/11/2021 | 23/12/2021 | 31 DAYS | 10 | 2 | Y | NONE | N | QUADRIPARESIS | 4 | 4 | 4 |
| 10 | 1212407 | SK | 50 | MALE | BUSINESS | RSA | 2 | 23/11/2021 | 9:00 PM | AUTUMN | 23/11/2021 | 04/01/2022 | 41 DAYS | 15 | 3 | N | NONE | N | QUADRIPLEGIA | 3 | 2 | 2 |
| 11 | 1215030 | KS | 25 | MALE | STUDENT | RSA | 4 | 24/11/2021 | 4:00 PM | AUTUMN | 27/11/2021 | 14/12/2021 | 18 DAYS | 15 | 3 | N | BILATERAL HYDROPENUMOTHORAX | N | QUADRIPLEGIA | 1 | 0 | 0 |
| 12 | 1216474 | DS | 74 | MALE | FARMER | RSA | 2 | 29/11/2021 | 10:00 AM | AUTUMN | 29/11/2021 | 16/12/2021 | 18 DAYS | 15 | 3 | N | NONE | DIABETES | QUADRIPLEGIA | 3 | 3 | 3 |
| 13 | 1217153 | MS | 42 | MALE | FARMER | RSA | 2 | 01/12/2021 | 9:00 PM | WINTER | 02/12/2021 | 23/12/2021 | 21 DAYS | 8 | 1 | Y | DAI | N | QUADRIPARESIS | 3 | 2 | 0 |
| 14 | 1236277 | HS | 23 | MALE | STUDENT | RSA | 4 | 07/12/2021 | 6:00 PM | WINTER | 02/01/2022 | 09/01/2022 | 7 DAYS | 6 | 1 | Y | NONE | SEPTIC SHOCK | QUADRIPLEGIA | 2 | 2 | 0 |
| 15 | 1228144 | NSM | 30 | MALE | STUDENT | RSA | 2 | 08/12/2021 | 4:00 PM | WINTER | 22/12/2021 | 31/12/2021 | 9 DAYS | 15 | 3 | N | NONE | N | QUADRIPLEGIA | 2 | 3 | 0 |
| 16 | 1227447 | JK | 50 | FEMALE | HOMEMAKER | RSA | 4 | 18/12/2021 | 6:00 PM | WINTER | 21/12/2021 | 30/12/2021 | 9 DAYS | 15 | 3 | N | NONE | HYPERTENSION | QUADRIPLEGIA | 4 | 3 | 1 |
| 17 | 1230940 | JS | 55 | MALE | FARMER | RSA | 4 | 22/12/2021 | 7:00 PM | WINTER | 22/12/2021 | 29/12/2021 | 7 DAYS | 15 | 3 | N | NONE | HYPERTENSION | QUADRIPLEGIA | 2 | 2 | 2 |
| 18 | 1232799 | SS | 25 | MALE | STUDENT | FALL FROM HEIGHT | balcony | 01/01/2022 | 4:00 PM | WINTER | 01/01/2022 | 13/01/2022 | 12 DAYS | 15 | 3 | N | NONE | N | QUADRIPLEGIA | 2 | 1 | 1 |
| 19 | 902580 | TR | 73 | MALE | DEPENDENT | DOMESTIC FALL | bathroom | 06/01/2022 | 11:00 PM | WINTER | 08/01/2022 | 09/02/2022 | 31 DAYS | 15 | 3 | N | NONE | N | PARAPARESIS | 5 | 5 | 5 |
| 20 | 1425655 | PS | 58 | MALE | FARMER | DOMESTIC FALL | bathroom | 08/01/2022 | 6:00 PM | WINTER | 09/01/2022 | 18/01/2022 | 9 DAYS | 15 | 3 | N | NONE | N | PARAPARESIS | 5 | 5 | 5 |
| 21 | 1448479 | GJ | 30 | MALE | STUDENT | FALL FROM HEIGHT | balcony | 20/01/2022 | 7:00 PM | WINTER | 21/01/2022 | 10/02/2022 | 20 DAYS | 15 | 3 | N | NONE | SPINAL SHOCK | QUADRIPLEGIA | 1 | 1 | 1 |
| 22 | 1448525 | NDS | 58 | MALE | BUSINESS | RSA | 4 | 20/01/2022 | 5:00 PM | WINTER | 20/02/2022 | 28/02/2022 | 8 DAYS | 15 | 3 | N | NONE | N | QUADRIPLEGIA | 3 | 3 | 3 |
| 23 | 144842 | HS | 30 | MALE | STUDENT | FALL FROM HEIGHT | stairs | 22/01/2022 | 9:00 PM | WINTER | 23/01/2022 | 02/02/2022 | 10 DAYS | 15 | 3 | N | LEFT CLAVICLE AND RIBS | N | PARAPLEGIA | 5 | 5 | 5 |
| 24 | 1449809 | N | 29 | MALE | STUDENT | RSA | 2 | 22/01/2022 | 7:00 AM | WINTER | 22/01/2022 | 12/02/2022 | 21 DAYS | 15 | 3 | N | NONE | N | PARAPLEGIA | 5 | 5 | 5 |
| 25 | 1454036 | NK | 18 | MALE | STUDENT | RSA | 2 | 30/01/2022 | 1:00 PM | WINTER | 30/01/2022 | 18/02/2022 | 19 DAYS | 4 | 1 | Y | POST CPR , RIGHT LEG BOTH BONES FRACTURE, HYPOXIC BRAIN INJURY | SEPTIC SHOCK | QUADRIPLEGIA | 1 | 0 | 0 |
| 26 | 1247395 | NK | 82 | FEMALE | DEPENDENT | RSA | 4 | 01/02/2022 | 1:30 PM | WINTER | 01/02/2022 | 07/02/2022 | 6 DAYS | 15 | 3 | N | NONE | HYPERTENSION | QUADRIPARESIS | 3 | 2 | 2 |
| 27 | 1251166 | MK | 50 | FEMALE | HOMEMAKER | RSA | 4 | 09/02/2022 | 5:00 PM | WINTER | 09/02/2022 | 14/02/2022 | 5 DAYS | 15 | 3 | N | LEFT CLAVICLE AND RIGHT SCAPULA | N | NO DEFICIT | 5 | 5 | 5 |
| 28 | 1255410 | GS | 25 | MALE | STUDENT | FALL FROM HEIGHT | stairs | 17/02/2022 | 9:00 AM | WINTER | 17/02/2022 | 27/02/2022 | 10 DAYS | 15 | 3 | N | NONE | N | QUADRIPLEGIA | 2 | 2 | 2 |
| 29 | 1257628 | AS | 24 | MALE | STUDENT | RSA | 2 | 19/02/2022 | 2:30 PM | WINTER | 21/02/2022 | 02/03/2022 | 9 DAYS | 15 | 3 | N | NONE | N | QUADRIPLEGIA | 2 | 2 | 2 |
| 30 | 1260201 | JS | 35 | MALE | BUSINESS | RSA | 4 | 24/02/2022 | 4:00 PM | WINTER | 25/02/2022 | 05/04/2022 | 39 DAYS | 14 | 3 | N | RIGHT SDH, LEFT PNEUMOTHORAX , LEFT CLAVICLE AND BRACHIAL PLEXUS INJURY | N | QUADRIPLEGIA | 3 | 3 | 3 |
| 31 | 1260161 | BS | 50 | MALE | FARMER | FALL FROM HEIGHT | stairs | 25/02/2022 | 4:00 PM | WINTER | 25/02/2022 | 28/03/2022 | 31 DAYS | 8 | 1 | Y | DAI | N | NO DEFICIT | 5 | 5 | 5 |
| 32 | 276380 | NS | 85 | MALE | DEPENDENT | DOMESTIC FALL | bathroom | 15/03/2022 | 6:00 PM | SPRING | 25/03/2022 | 26/03/2022 | 1 DAY | 10 | 2 | Y | NONE | N | PARAPLEGIA | 5 | 5 | 5 |
| 33 | 1277163 | BS | 46 | MALE | FARMER | RSA | 2 | 24/03/2022 | 6:30 PM | SPRING | 27/03/2022 | 06/04/2022 | 10 DAYS | 10 | 2 | Y | NONE | N | QUADRIPLEGIA | 2 | 3 | 2 |
| 34 | 1287825 | GS | 62 | FEMALE | HOMEMAKER | RSA | 4 | 14/04/2022 | 7:00 PM | SPRING | 14/04/2022 | 26/04/2022 | 12 DAYS | 15 | 3 | N | NONE | DIABETES | QUADRIPLEGIA | 5 | 5 | 3 |
| 35 | 1288795 | MS | 62 | MALE | FARMER | FALL FROM HEIGHT | balcony | 16/04/2022 | 8:00 AM | SPRING | 16/04/2022 | 16/05/2022 | 30 DAYS | 11 | 2 | N | RIGHT TEMPORAL CONTUSION | HYPERTENSION | QUADRIPARESIS | 4 | 3 | 4 |
| 36 | 1294884 | JP | 87 | MALE | DEPENDENT | RSA | 2 | 27/04/2022 | 5:30 PM | SPRING | 28/04/2022 | 06/06/2022 | 38 DAYS | 15 | 3 | Y | BILATERAL PNEUMOHAEMOTHORAX | DIABETES | QUADRIPLEGIA | 2 | 2 | 1 |
| 37 | 1304299 | GS | 45 | MALE | BUSINESS | FALL FROM ELECTRIC POLE | electric pole | 12/05/2022 | 7:00 PM | SPRING | 15/05/2022 | 31/05/2022 | 16 DAYS | 15 | 3 | N | ELECTRIC BURN | N | QUADRIPARESIS | 4 | 4 | 4 |
| 38 | 1312497 | PS | 32 | MALE | BUSINESS | RSA | 4 | 17/05/2022 | 6:00 PM | SUMMER | 17/05/2022 | 03/06/2022 | 17 DAYS | 15 | 3 | N | RIGHT RADIUS FRACTURE | N | QUADRIPLEGIA | 2 | 2 | 1 |
| 39 | 1311672 | PR | 27 | FEMALE | STUDENT | RSA | 4 | 25/05/2022 | 3:00 PM | SUMMER | 26/05/2022 | 15/06/2022 | 20 DAYS | 15 | 3 | N | NONE | N | QUADRIPLEGIA | 2 | 1 | 1 |
| 40 | 1366865 | LS | 27 | MALE | STUDENT | RSA | 2 | 25/06/2022 | 5:00 PM | SUMMER | 25/06/2022 | 30/06/2022 | 5 DAYS | 15 | 3 | N | NONE | N | PARAPLEGIA | 5 | 5 | 5 |
| 41 | 1333579 | RK | 29 | FEMALE | STUDENT | RSA | 4 | 30/06/2022 | 9:00 PM | SUMMER | 01/07/2022 | 15/07/2022 | 14 DAYS | 15 | 3 | N | NONE | N | NO DEFICIT | 5 | 5 | 5 |
| 42 | 1342890 | AG | 27 | MALE | STUDENT | RSA | 4 | 17/07/2022 | 2:30 AM | SUMMER | 17/07/2022 | 15/08/2022 | 28 DAYS | 15 | 3 | N | LIVER INJURY | N | QUADRIPLEGIA | 1 | 1 | 1 |
| 43 | 1356699 | HS | 59 | MALE | FARMER | DOMESTIC FALL | bathroom | 08/08/2022 | 2:00 PM | SUMMER | 08/08/2022 | 28/08/2022 | 20 DAYS | 15 | 3 | N | NONE | DIABETES | QUADRIPARESIS | 4 | 4 | 3 |

| S No. | MRD | LOWER LIMB | LEVEL OF SPINE INJURY | TYPE OF FRACTURE | LISTHESIS | CORD STATUS | ASIA SCORE | MANAGEMENT | MAS SCORE ON 6 MONTH FOLLOW UP | CAUSE OF DEATH |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 471040 | 0 | C5/C6 AND D12 | WEDGE FRACTURE | YES | CORD CONTUSION | A | CONSERVATIVE MANAGEMENT | 4 | N |
| 2 | 1172834 | 5 | C2/C3 | BURST FRACTURE | YES | NO | A | SURGERY | 0 | N |
| 3 | 1136820 | 0 | C6 | WEDGE FRACTURE | YES | CORD CONTUSION +COMPRESSION | A | SURGERY | 4 | N |
| 4 | 1185399 | 0 | C3/6 AND T12/L1 FRACTURE | BURST FRACTURE | NO | COMPRESSION | A | SURGERY | 3 | N |
| 5 | 1192629 | 0 | C2/C3 | ODONTOID FRACTURE | NO | CORD CONTUSION | A | CONSERVATIVE MANAGEMENT | 6 | respiratory failure |
| 6 | 1207614 | 0 | C2/C3 | WEDGE FRACTURE | YES | CORD CONTUSION | D | CONSERVATIVE MANAGEMENT | 6 | sepsis |
| 7 | 1211912 | 0 | C6/C7 | SUBLUXATION | YES | CORD CONTUSION | A | CONSERVATIVE MANAGEMENT | 4 | N |
| 8 | 1212615 | 3 | C5/C6 | BURST FRACTURE | NO | CORD CONTUSION | A | CONSERVATIVE MANAGEMENT | 4 | N |
| 9 | 1211292 | 0 | C6/C7 | SUBLUXATION | NO | CORD CONTUSION | A | CONSERVATIVE MANAGEMENT | 2 | N |
| 10 | 1212407 | 2 | C4/6 | WEDGE FRACTURE | NO | CORD COMPRESSION | D | SURGERY | 3 | N |
| 11 | 1215030 | 0 | C2/C3 | SUBLUXATION | NO | CORD CONTUSION | A | CONSERVATIVE MANAGEMENT | 5 | N |
| 12 | 1216474 | 0 | C5/C6 | BURST FRACTURE | NO | CORD CONTUSION | A | CONSERVATIVE MANAGEMENT | 3 | N |
| 13 | 1217153 | 0 | C4/C5 | WEDGE FRACTURE | NO | CORD CONTUSION | NO | CONSERVATIVE MANAGEMENT | 5 | N |
| 14 | 1236277 | 0 | C3/C4 | SUBLUXATION | NO | CORD CONTUSION | NO | CONSERVATIVE MANAGEMENT | 6 | sepsis |
| 15 | 1228144 | 0 | C4/C5 | SUBLUXATION | NO | CORD CONTUSION | A | CONSERVATIVE MANAGEMENT | 4 | N |
| 16 | 1227447 | 0 | C3/C4 | SUBLUXATION | NO | CORD CONTUSION +COMPRESSION | A | SURGERY | 2 | N |
| 17 | 1230940 | 2 | C3/C4 | BURST FRACTURE | NO | CORD CONTUSION +COMPRESSION | A | CONSERVATIVE MANAGEMENT | 5 | N |
| 18 | 1232799 | 0 | C4 | BURST FRACTURE | NO | CORD CONTUSION | A | CONSERVATIVE MANAGEMENT | 3 | N |
| 19 | 902580 | 3 | L4 | BURST FRACTURE | NO | NO | D | SURGERY | 3 | N |
| 20 | 1425655 | 4 | L4 | SPINOUS PROCESS FRACTURE | NO | NO | D | SURGERY | 1 | N |
| 21 | 1448479 | 0 | C6/C7 | BURST FRACTURE | YES | CORD COMPRESSION | A | SURGERY | 4 | N |
| 22 | 1448525 |  | C3/5 | WEDGE FRACTURE | NO | CORD CONTUSION | C | CONSERVATIVE MANAGEMENT | 5 | N |
| 23 | 144842 | 0 | D12 AND L1 | BURST FRACTURE | NO | CORD CONTUSION +COMPRESSION | B | SURGERY | 4 | N |
| 24 | 1449809 | 2 | L2 | BURST FRACTURE | NO | CORD COMPRESSION | B | SURGERY | 3 | N |
| 25 | 1454036 | 0 | C1/2 | C1 ARCH AND ODONTOID FRACTURE | YES | CORD TRANSECTION | NO | CONSERVATIVE MANAGEMENT | 6 | shock |
| 26 | 1247395 | 4 | C6/C7 | BURST FRACTURE | YES | CORD COMPRESSION | A | SURGERY | 2 | N |
| 27 | 1251166 | 5 | C2 | HANGMAN FRACTURE | NO | NO | E | CONSERVATIVE MANAGEMENT | 0 | N |
| 28 | 1255410 | 0 | C4/6 | SUBLUXATION | NO | CORD CONTUSION | A | CONSERVATIVE MANAGEMENT | 5 | N |
| 29 | 1257628 | 0 | C5 | BURST FRACTURE | YES | COMPRESSION | A | SURGERY | 4 | N |
| 30 | 1260201 | 4 | C2/C3 | SUBLUXATION | YES | CORD CONTUSION | D | CONSERVATIVE MANAGEMENT | 2 | N |
| 31 | 1260161 | 5 | D12 | BURST FRACTRUE | NO | NO | NO | SURGERY | 0 | N |
| 32 | 276380 | 0 | D6 FRACTURE | BURST FRACTURE | NO | CORD CONTUSION | E | SURGERY | 4 | N |
| 33 | 1277163 | 0 | C5/C6 | SUBLUXATION | NO | CORD CONTUSION | A | CONSERVATIVE MANAGEMENT | 5 | N |
| 34 | 1287825 | 0 | C6/C7 | SUBLUXATION | NO | CORD CONTUSION | C | CONSERVATIVE MANAGEMENT | 4 | N |
| 35 | 1288795 | 3 | C6/C7 | SUBLUXATION | YES | CORD COMPRESSION | A | SURGERY | 4 | N |
| 36 | 1294884 | 0 | C3/C4 | BURST FRACTURE | NO | CORD CONTUSION | A | CONSERVATIVE MANAGEMENT | 4 | N |
| 37 | 1304299 | 4 | C6/C7 | BURST FRACTURE | YES | CORD COMPRESSION | D | SURGERY | 2 | N |
| 38 | 1312497 | 0 | C4/6 | SUBLUXATION | NO | CORD CONTUSION | A | CONSERVATIVE MANAGEMENT | 5 | N |
| 39 | 1311672 | 0 | C6/C7 | SUBLUXATION | YES | CORD CONTUSION +COMPRESSION | A | SURGERY | 4 | N |
| 40 | 1366865 | 2 | D10 | BURST FRACTURE | NO | CORD COMPRESSION | A | SURGERY | 4 | N |
| 41 | 1333579 | 5 | C4/C5 | SPINOUS PROCESS FRACTURE | NO | NO | E | CONSERVATIVE MANAGEMENT | 0 | N |
| 42 | 1342890 | 0 | C5/C6 | SUBLUXATION | YES | CORD TRANSECTION | E | CONSERVATIVE MANAGEMENT | 5 | N |
| 43 | 1356699 | 0 | C5/C6 | WEDGE FRACTURE | NO | CONTUSION + COMPRESSION | A | SURGERY | 4 | N |

No. BFUHS/2K21p-III/ 101

Date 6/1/22

The Principal,
DMC, Ludhiana.

Subject: **Approval of Plan of Thesis.**

This is to inform you that the Faculty of Medical Sciences in its meeting held on 29.10.2021 has approved the plan of thesis of **Swarjith Nimmakayala**, a student of your college for **MCh Neuro-Surgery** along with the names of Supervisor/Co-Supervisor as under:-

**Topic Plan of Thesis**

Clinico-radiological profile of spine injury at dayanand medical college and hospital.

**Supervisor**
Dr. Ashwani K. Chaudhary
Prof. & Head,
Dept. of Neuro-Surgery,
DMCH, Ludhiana.

**Co-Supervisor**

Dr. Hanish Bansal
Assoc. Prof.,
Dept. of Neuro-Surgery,
DMCH, Ludhiana.

The student has to submit the four copies of thesis (along with PDF format) , to the Controller of Examinations, BFUHS, Faridkot, at least six months before the commencement of theory examination, if he/she is otherwise eligible to take the examination. He /She must directed to attach a photocopy of this letter with the forwarding letter while submitting thesis to the University along with the letter of approval of University for change of supervisor/Co-Supervisor, change of topic,( if any).

Dr. S P Singh MS(Oph)
Controller of Examinations

*Note :*

*177. If any discrepancy found regarding topic of thesis or Supervisor/Co-Supervisor, inform undersigned within one month after issue of this letter.*

*178. The student may submit the thesis as per the schedule already conveyed i.e for May/June examination 30th Nov of the preceding the year of examination and for Nov/Dec examinations 31st May of the year of examination.*

# CLINICO-RADIOLOGICAL PROFILE OF SPINE INJURY AT DAYANAND MEDICAL COLLEGE AND HOSPITAL

## THESIS PROPOSAL

FOR APPROVAL OF SUBJECT OF THESIS TO BE SUBMITTED
IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

**M.Ch.**

**In**

**NEUROSURGERY**

**OF THE**

**BABA FARID UNIVERSITY OF HEALTH SCIENCES**
**FARIDKOT**

**AUGUST, 2021**

**DR. SWARJITH NIMMAKAYALA**

DEPARTMENT OF NEUROSURGERY
DAYANAND MEDICAL COLLEGE AND HOSPITAL
LUDHIANA

## ABSTRACT OF PLAN OF THESIS

| | |
|---|---|
| Title | CLINICO-RADIOLOGICAL PROFILE OF SPINE INJURY AT DAYANAND MEDICAL COLLEGE AND HOSPITAL |
| For the degree of | M.Ch. Neurosurgery |
| Name of the candidate | Dr. Swarjith Nimmakayala |
| Supervisor | Dr. Ashwani K Chaudhary, Professor & Head, Department of Neurosurgery, DMCH, Ludhiana |
| Co-supervisor | Dr. Hanish Bansal, Associate Professor, Department of Neurosurgery, DMCH, Ludhiana |
| Institution | Dayanand Medical College & Hospital, Ludhiana |
| University | Baba Farid University of Health Sciences, Faridkot |


### INTRODUCTION

Spinal injury is one of the most devastating injuries having a great impact on patients, their families and the society. The major cause of injury (leading etiology) in developed world is due to motor vehicle accidents. Fall from height is the most common injury etiology in the Southern Asia. It may lead to serious disability with long term medical complications, including pressure ulcers, autonomic dysreflexia, deep venous thrombosis and pneumonia, distress, depression, anxiety and suicide attempts.

### AIMS & OBJECTIVES

To determine clinic-radiological profile of spinal injuries in our institute and to identify prognostic factors and determine outcome.

### MATERIAL & METHODS

Present study will be conducted in patients admitted with traumatic spine injury in the causality and department of neurosurgery of Dayanand medical college and hospital Ludhiana.

### CLINICAL SIGNIFICANCE

Our study aims to know the incidence of traumatic spine injury, clinical and radiological correlation as well as to assess the outcome of traumatic spine injury.



### KEYWORDS

Spine, radiology, morbidity, complications.


**Candidate's sign** **Co- supervisor's sign** **Supervisor's sign** **Principal's sign**

## CERTIFICATE OF FACILITIES AVAILABLE

This is to certify that the facilities for work on the subject of thesis titled **"CLINICO-RADIOLOGICAL PROFILE OF SPINE INJURY AT DAYANAND MEDICAL COLLEGE AND HOSPITAL"** exist in the Department of Neurosurgery, Dayanand Medical College, Ludhiana will be provided to the candidate. We will see that the data being included in the thesis are genuine & is collected by the candidate himself under our supervision & guidance.

**Supervisor**

**Dr. Ashwani K Chaudhary**
Professor & Head
Department of Neurosurgery
DMCH, Ludhiana

**Co-Supervisor**

**Dr. Hanish Bansal**
Associate Professor
Department of Neurosurgery
DMCH, Ludhiana

**Dr. Ashwani K Chaudhary**
Professor & Head
Department of Neurosurgery
DMCH, Ludhiana

Place: Ludhiana

Date:

**APPROVAL PROFORMA**
**BY RESEARCH & ETHICAL COMMITTEE**
**DAYANAND MEDICAL COLLEGE & HOSPITAL, LUDHIANA**

| | |
|---|---|
| **Name of candidate** | Dr. Swarjith Nimmakayala |
| **Department** | Neurosurgery |
| **Topic of Thesis** | CLINICO-RADIOLOGICAL PROFILE OF SPINE INJURY AT DAYANAND MEDICAL COLLEGE AND HOSPITAL |
| **Likely date of appearing in PG examination** | May-June 2023 |
| **Date of enrollment** | 11 January 2021 |
| **Name of Head of Department** | Dr. Ashwani K Chaudhary |
| **1) Supervisor**<br><br>**2) Co-Supervisor** | Dr. Ashwani K Chaudhary<br><br>Dr. Hanish Bansal |
| **Signature of Members of Research Committee with Stamp** | **Signature of Members of Ethics Committee with Stamp** |
| Dr. Harpreet Kaur<br>(Professor & Head, Pathology) | Mr. R K Sharma<br>(Legal Expert) |
| Dr. Jaspal Singh<br>(Professor & Head, Surgery) | Dr. Ramit Mahajan<br>(Associate Professor, Gastroenterology) |
| Dr. Dinesh Gupta<br>(Professor & Head, Medicine) | Dr. Anu Sharma<br>(Professor, Anatomy) |
| Dr. Sandeep Kaushal<br>(Dean Academics &<br>Professor & Head, Pharmacology) | Dr. Sandeep Kaushal<br>(Dean Academics &<br>Professor & Head, Pharmacology) |
| Dr. Gurpreet S Wander<br>(Vice Principal) | Dr. Gurpreet S Wander<br>(Vice Principal &<br>Professor & Head, Cardiology) |
| | Dr. Gagandeep Singh<br>(Secretary, Ethics Committee<br>Professor & Head, Neurology) |

**Approved: Yes / No**

**Chairperson**
**Research Committee**
Chairperson
Research Committee

**Approved: Yes / ~~No~~**

**Chairperson**
**Ethics Committee**
Chairperson
Ethics Committee

# BABA FARID UNIVERSITY OF HEALTH SCIENCES, FARIDKOT

## PROFORMA FOR REGISTRATION OF SUBJECT FOR DISSERTATION

| | | |
|---|---|---|
| 1 | NAME OF THE CANDIDATE AND ADDRESS | DR. SWARJITH NIMMAKAYALA<br>FLAT C-201 TRIMURTI ARIANA APARTMENTS, NEAR SKIT COLLEGE, JAGATPURA, JAIPUR, RAJASTHAN-302022. |
| 2 | NAME OF THE INSTITUTE | DAYANAND MEDICAL COLLEGE AND HOSPITAL, LUDHIANA |
| 3 | COURSE OF STUDY AND SUBJECT | M.CH. NEUROSURGERY |
| 4 | DATE OF ADMISSION OF COURSE | 11$^{TH}$ JANUARY 2021 |
| 5 | TITLE OF THE TOPIC | CLINICO-RADIOLOGICAL PROFILE OF SPINE INJURY AT DAYANAND MEDICAL COLLEGE AND HOSPITAL |

## 6. BRIEF RESUME OF THE INTENDED WORK

### 6.1 NEED FOR STUDY

Traumatic spinal injuries comprises of column fractures, spinal cord injury or both. Spinal injury is one of the most devastating injuries having a great impact on patients, their families and the society. It may lead to serious disability when involving the spinal cord with long term medical complications, including pressure ulcers, autonomic dysreflexia, deep venous thrombosis and pneumonia. People with spinal injury have a high level of distress, depression, anxiety and suicide attempts because of their lower levels of life satisfaction. The cost of spine injuries and their effects on health care system are high[1]. Global prevalence rates of traumatic spine injury varied from 200 to 1000 per million and data on incidence varied from approximately 15 to 50 per million. The major cause of injury in developed world is due to motor vehicle accidents. Fall from height is the most common injury etiology in the Southern Asia. India estimates suggest incidence around 15 to 20 per million per year population. Commonest mode of injuries in India is fall from height [2].

Kang et al reported that the cervical level of spine was the most common part of injury in both developed countries and underdeveloped countries[4]. In thoracolumbar region L1 was the most common site of fracture followed by T12, L4, L2-L3, T11 and T5 [3].

In order to fight with this dreaded situation, a deep understanding of various aspects like management issues, complications, new developments etc is essential. It is also very important to make proper guidelines for trials of such patients and training of medical individual. Identification of local problems in transportation and care is also to be taken into consideration[2].

## 6.2 REVIEW OF LITERATURE

Incidence and prevalence of spinal cord injury (SCI) have increased along with expansion of human activity. The incidence rates in developed countries range from 13.12 to 163.42 per million people. The rates in underdeveloped countries varied from 13 to 220 per million people[4]. In India estimated incidence is 20 per million per year population[2]. Singh et al in an epidemiological study mentioned that approximately 20,000 new cases of spinal cord injury are added every year[6].Furlan et al stated that prevalence of traumatic spinal cord injury documented rates from 50 to 1298 cases per million population worldwide.

Reported prevalence rates of traumatic spine injury are 849.8 cases per million population in Nepal and 236 cases per million population in India[7]. The average age at the time of injury varies from 26.8 years in a study from Turkey to 55.5 years in Oklahoma, USA. There is a trend of increase in average age at the time of injury in recent decades[2]. In the National spinal cord injury statistical centre database (US), the average age at the time of injury was 29 years in 1970 and 37 years in 2005[8,9]. Pavan et al stated that the maximum number of patients with spinal injuries in India is between the age group of 20-39 years. Study from All India institute of Medical Sciences, New Delhi, India shows that among patients with spinal cord injuries, 40.9% of them were in third decade[11].

Jackson et al stated that the male to female ratio of traumatic spinal cord injuries is 4: 1[12]. Shalini et al stated that most of the spine injuries in the age group of 18 to 64 years were more likely to be male[13]. Bidre et al in a retrospective study in All India institute of Medical Sciences, India, from January 1990 to May 2000, showed that among 440 patients with spinal cord injuries, females comprised 17.95% while 82.04% where males(M:F 4.58:1)[11]. Chen et al stated that most common causes of spinal cord injury were automobile crashes (31.5%) and falls (25.3%), followed by gunshot wounds (10.4%), motorcycle crashes (6.8%), diving incidents (4.7%) and medical/surgical complications (4.3%), which collectively accounted for 83.1% of total

spinal cord injuries since 2005. Automobile crashes were the leading cause of spinal cord injury until age 45 years, whereas falls were the leading cause after 45 years[14.] Singh et al stated that in India with developing infrastructure, economy and social status, around 45% cases of acute spinal cord injury (ASCI) occurred because of fall from top of trees or roof or electricity pole or terraces followed by road traffic accidents (35%).[6] Similar results of ASCI where fall from height is the commonest cause have been reported by Bidre et al, Chako et al and shanmugasundaram[11,15,16]. Violence was a frequent cause of traumatic spinal cord injury in South Africa, where it accounts for 61-62% of the cases, whereas all studies from Europe reported less than 5% with the exception of Greenland, where violence was the cause in 11% of cases.[2]

Kang et al reported that the cervical level of spine was the most common part of injury in both developed countries and underdeveloped countries. Most articles reported a lower percentage of complete injury than incomplete injury. In our review, when classifying the types of disabilities caused by spinal cord injury, the quadriplegia was more common than paraplegia in both developed and underdeveloped countries except Turkey and Canada[4].

Most developed countries possess an effective trauma care and transport system, which efficiently transports the victims, usually within first 12-24 hours, to the definitive care centers via well equipped ambulances[18]. Bidre et al reported that only 59.1% of the victims reached the institute within first 48 hours and only 47.7% of the patients with spinal trauma were transported in an ambulance. It was also evident from this study that most of the victims were transported 2.4 times between various health centers before reaching the definitive spinal care center. Only 7.27% of the patients were transferred directly to the institute and the average number of transfer was 3.4 per patient[10]. Sezar et al reported common complications of spinal cord injury including respiratory complications (pneumonia/atelectasis-3.5%), orthostatic hypotension(21%), autonomic dysreflexia (19-70%), neurogenic bowel (46.9%), spasticity (97%), chronic pain (80%),

pressure ulcers ( ischium (31%) ,trochanters (26%) ,sacrum (18%) ,heel (5%) ,malleolus (4%) and feet (2%)[18]).

Hagan et al reported 401 patients with traumatic spinal cord injury from 1952-2001. By 31 August 2008, 173 were dead. Median survival time in deceased patients were 7.4 years; 6.9 years for patients with cervical injuries and 8.2 years for patients with thoracolumbar sacral injury (TLS). Standard mortality ratio (SMR) was significantly higher for women than for men (2.88 vs 1.72), and higher in patients with complete traumatic spinal cord injury (TSCI) compared with patients with incomplete traumatic spinal cord injury (4.23 vs 1.25). Standardised mortality ratio (SMR) was 6.7 in patients with complete cervical injuries and 3.07 for patients with complete thoracolumbar sacral injuries. Cause specific SMR was 1.96 for respiratory disease and for suicide including accidental poisoning 3.7 for men and 37.59 for women.[19]

Habib et al did a study in profile of spine trauma in Kashmir and reported a total of 667 cases from September 2003 to October 2013. The most prevalent age group was 21 to 40 years (49.93%). Most common mode of injury was fall from height (66.41%), followed by road traffic accident (28.63%); 38.08% had cervical, 31.64% had dorsal and 30.28% had lumbar spine injury. Trauma was most common in the month of August and was mainly due to fall from height; 69.61% were managed surgically and 30.58% conservatively; 41.22% patients showed improvement in neurological grade, 20.68% made complete recovery, 26.53% showed no neurological improvement.[20]

## 6.3 AIMS AND OBJECTIVES

1. To determine clinico-radiological profile of spinal injuries in our institute.
2. To identify prognostic factors and determine outcome.

## 7.0 MATERIAL AND METHODS:

### 7.1 SOURCE OF DATA:

- The patients presenting to Dayanand Medical College and Hospital emergency, Ludhiana, Emergency with traumatic spine injury will be taken into study group. The study period will extend from 1st September 2021 to 31st August 2022.

### 7.2 METHODS OF COLLECTION OF DATA

- Detailed clinical and neurological examinations will be performed in all patients. MRI whole spine screening will be performed in all patients who have any of the following factors—severe mode of injury, spinal pain or tenderness and in patients older than 60 years of age, patients with neurological deficit.
- Data extracted will include the following - Age, socio economic status, gender, Etiology, injury characteristics, severity, management, complications and outcome.
- For classifying injury severity we will use American spinal injury association (ASIA) scale. Outcome will be defined by the state of the patient on discharge. Statistical analysis will be done using SPSS (statistical package for social science).
- P-value <0.05 will be taken as significant.

**Inclusion criteria:**

- All the patients with spinal injury with or without neuro deficit.

**Exclusion criteria:**

- Pathological fractures and fractures due to systemic prolonged illness.

**Duration of study**

This prospective study will be conducted in the department of neurosurgery Dayanand medical college and hospital, Ludhiana over a period of 1 year from 1st September 2021 to 31st August 2022 and will

include all the patients with spinal injuries presenting to department of neurosurgery Dayanand medical college and hospital over this period.

**Statistical Analysis**

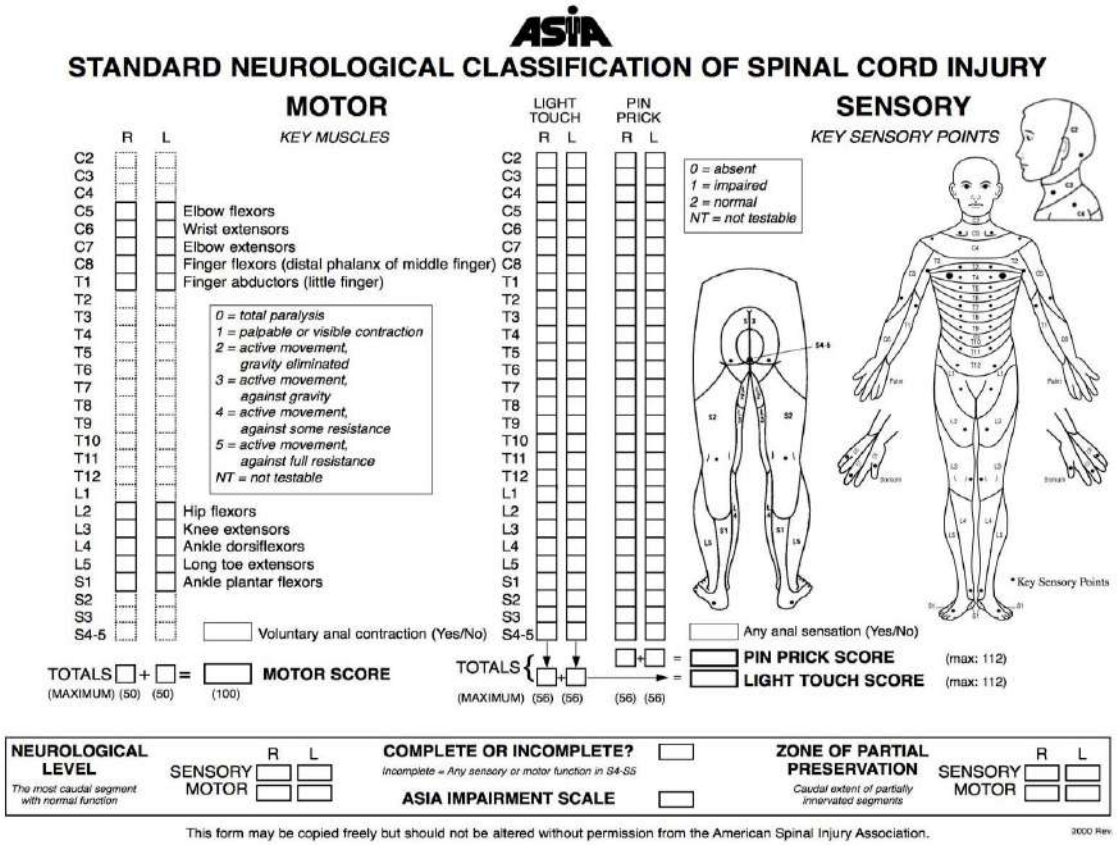
Data will be described in terms of range; mean ±standard deviation (± SD), median, frequencies (number of cases) and relative frequencies (percentages) as appropriate. All statistical calculations will be done using (Statistical Package for the Social Science) SPSS 21version (SPSS Inc., Chicago, IL, USA) statistical program for Microsoft Windows.

**Management plan**

- Patients will be managed according to the examination and radiological findings and appropriate management plan will be decided whether surgical or non surgical. ICU care and ventilator and ionotropic support will be given as required.

**Outcome**

- Outcome will be assessed at the end of hospital-discharge and on regular follow up at 1 month and 3 months. Outcome will be graded as no recovery (no evidence of clinical improvement in the nerve function), partial recovery (some objective clinical recovery), or complete recovery (at the end of the follow-up period, the patient was asymptomatic). Outcome was measured by modified Rankin Score (mRS).


ASIA
STANDARD NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY
MOTOR
KEY MUSCLES
SENSORY
KEY SENSORY POINTS
LIGHT TOUCH
PIN PRICK
R L
C2 C3 C4 C5 C6 C7 C8 T1 T2 T3 T4 T5 T6 T7 T8 T9 T10 T11 T12 L1 L2 L3 L4 L5 S1 S2 S3 S4-5
Elbow flexors
Wrist extensors
Elbow extensors
Finger flexors (distal phalanx of middle finger)
Finger abductors (little finger)
Hip flexors
Knee extensors
Ankle dorsiflexors
Long toe extensors
Ankle plantar flexors
0 = total paralysis
1 = palpable or visible contraction
2 = active movement, gravity eliminated
3 = active movement, against gravity
4 = active movement, against some resistance
5 = active movement, against full resistance
NT = not testable
0 = absent
1 = impaired
2 = normal
NT = not testable
Voluntary anal contraction (Yes/No)
Any anal sensation (Yes/No)
TOTALS + = MOTOR SCORE
(MAXIMUM) (50) (50) (100)
TOTALS
(MAXIMUM) (56) (56)
(56) (56)
PIN PRICK SCORE (max: 112)
LIGHT TOUCH SCORE (max: 112)
*Key Sensory Points
NEUROLOGICAL LEVEL
The most caudal segment with normal function
SENSORY
MOTOR
COMPLETE OR INCOMPLETE?
Incomplete = Any sensory or motor function in S4-S5
ASIA IMPAIRMENT SCALE
ZONE OF PARTIAL PRESERVATION
Caudal extent of partially innervated segments
This form may be copied freely but should not be altered without permission from the American Spinal Injury Association.
2000 Rev.

## Modified Rankin Scale (MRS)

0 No symptoms
1 No significant disability, despite symptoms; able to perform all usual duties and activities
2 Slight disability; unable to perform all previous activities but able to look after own affairs without assistance
3 Moderate disability; requires some help, but able to walk without assistance
4 Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance
5 Severe disability; bedridden, incontinent, and requires constant nursing care and attention
6 Death

**7.3 DOES THE STUDY REQUIRE ANY INVESTIGATIONS OR INTERVENTIONS TO BE CONDUCTED ON PATIENTS OR OTHER HUMANS OR ANIMALS? IF SO, PLEASE DESCRIBE BRIEFLY.**

**7.4 HAS ETHICAL CLEARANCE BEEN OBTAINED FROM YOUR INSTITUTION**

ATTACHED HERE WITH

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## PROFORMA

S. No.

NAME: AGE:

GENDER: MRD:

RESIDENTIAL ADDRESS:

DOA: DOS: DOD:

PHONE: EMAIL:

DATE OF INJURY: TIME OF INJURY:

PLACE OF INJURY:

OCCUPATIONAL STATUS: FARMER/LABOUR/STUDENT/GOVT.EMPLOYEE/BUSINESS/PRIVATE EMPLOYEE/OTHERS

EDUCATIONAL STATUS: PRIMARY SCHOOL/HIGH SCHOOL/ JUNIOR COLLEGE/GRADUATION AND ABOVE

ROAD TYPE: PRIMARY SYSTEM/ SECONDARY SYSTEM/ TERTIARY SYSTEM

PRIMARY: NATIONAL HIGHWAY

SECONDARY: STATE AND MAJOR DISTRICT HIGHWAY

TERTIARY: DISTRICT AND RURAL ROAD

CAUSE OF INJURY:

A.FALL – TREE/SCAFFOLD/ BALCONY/ BATHROOM SLIP

B. RTA:

1. TWO WHEELER: MOTOR CYCLE/SCOOTER / SCOOTY/ BICYCLE

   DRIVER/PILLION

   HELEMT/ NO HELMET

2. FOUR WHEELER: LMV-COMMERCIAL/DOMESTIC HMV-COMMERCIAL/DOMESTIC

   DRIVER/FRONT SEAT/BACK SEAT

   SEAT BELT/NO SEAT BELT

3. CIRCUMSTANCES: GOING HOME/AWAY FROM HOME

   ALCOHOL/ NON ALCOHOL

   ANY DRUG COMSUMPTION

4. SPEED OF VEHICLE:

5. TYPE OF COLLISON: HEAD ON/ SIDE WAYS/ REAR HIT

6. DISTANCE TRAVELLED BEFORE ACCIDENT:

**Signature of Candidate** **Signature of Supervisor**

PEDESTRIAN:

1. TWO WHEELER: MOTOR CYCLE/COOTY/SCOOTER

2. FOUR WHEELER: LMV-COMMERCIAL/DOMESTIC HMV-COMMERCIAL/DOMESTIC

PLACE OF ACCIDENT: RURAL/ URBAN

3. FALL OF STONE/ HEAVY OBJECT ON HEAD:

4. FIREARM INJURY: BULLET/ TEAR GAS/ PELLET/ OTHERS

5. HOMICIDE

6. SUICIDE:

7. ELECTRIC SHOCK:

NEUROLOGICAL EXAMINATION: AT PRESENTATION:

1. GCS:
2. MOTOR EXAMINATION:
   a. POWER:

| | | | | | | |
|---|---|---|---|---|---|---|
| UPPER LIMB | MUSCLE | SHOULDER | ELBOW | WRIST | FINGERS | HAND GRIP |
| | RIGHT | | | | | |
| | LEFT | | | | | |
| LOWER LIMB | MUSCLE | HIP | KNEE | ANKLE | TOES | EHL |
| | RIGHT | | | | | |
| | LEFT | | | | | |

   b. SENSORY LOSS:
   c. PLANTAR:
3. REFLEX:
4. ASSOCIATED INJURIES:
5. ASIA GRADING: A B C D E
6. IMAGING FINDING:
   a. X RAY
   b. CT SPINE:
   c. MRI SPINE:
7. SPINAL FRACTURE:
   a. CERVICAL
   b. DORSAL
   c. LUMBAR
   d. SACRUM
8. FRACTURE: BURST# WEDGE # CHIP#
   SUBLUXATION – ANTERIOR/POSTERIOR

MRI FINDING:

CORD CONTUSION CORD TRANSECTION NO CORD INJURY

TREATMENT RECEIVED:

CONSERVATIVE OPERATIVE EMERGENCY SURGERY ELECTIVE SURGERY

**Signature of Candidate** **Signature of Supervisor**

ICU STAY (DAYS):

TRACHEOSTOMY YES/NO HOSPITAL STAY (DAYS):

CONDITION AT DISCHARGE:

NEUROLOGICAL EXAMINATION AT DISCHARGE:

1. GCS:
2. MOTOR EXAMINATION:
    a. POWER:

| | | | | | | |
|---|---|---|---|---|---|---|
| UPPER LIMB | MUSCLE | SHOULDER | ELBOW | WRIST | FINGERS | HAND GRIP |
| | RIGHT | | | | | |
| | LEFT | | | | | |
| LOWER LIMB | MUSCLE | HIP | KNEE | ANKLE | TOES | EHL |
| | RIGHT | | | | | |
| | LEFT | | | | | |

    b. SENSORY LOSS:
    c. PLANTAR:
3. REFLEX:

DEMISE IN HOSPITAL:

DVT: YES/NO

BED SORES: YES/NO

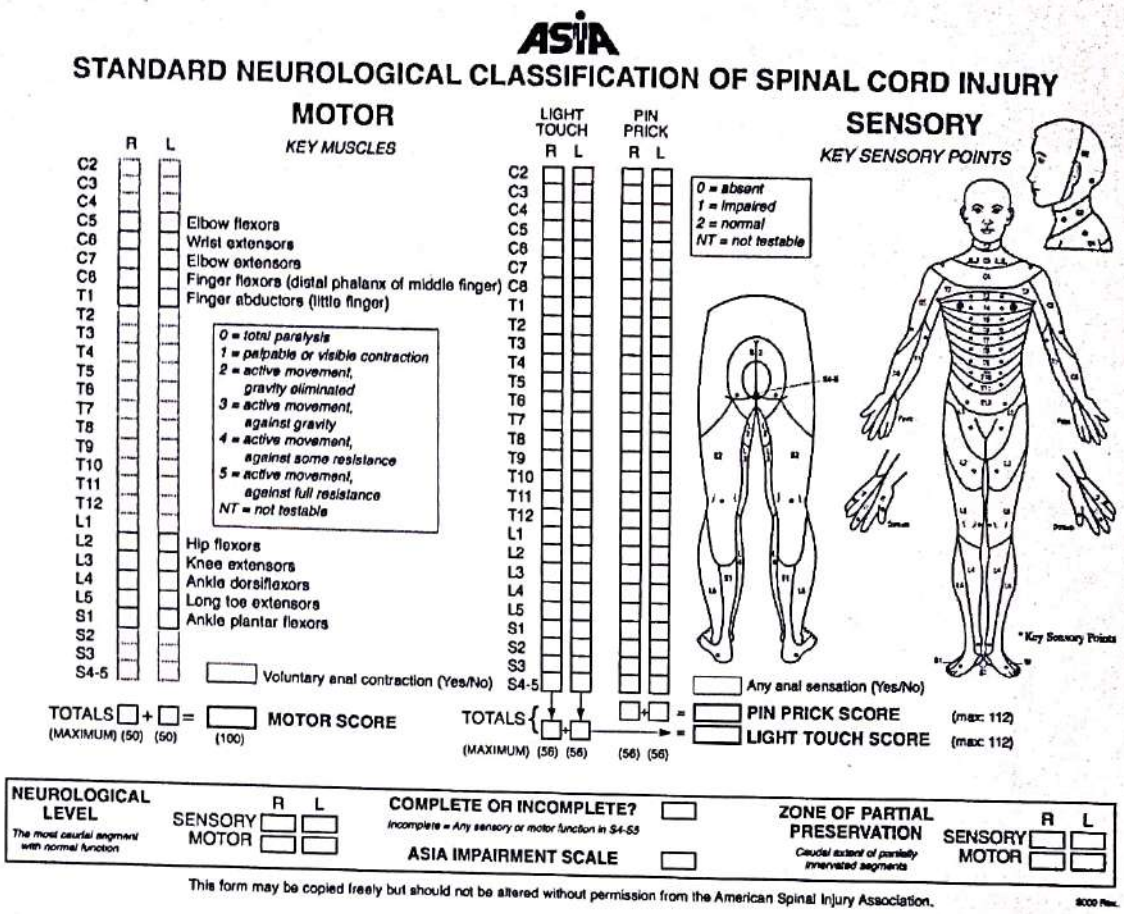
URINARY CATHETER: YES/NO

RYLES TUBE: YES/NO

AMBULATION: SELF WITH SUPPORT WHEEL CHAIR BED RIDDEN

Signature of Candidate

Signature of Supervisor


ASIA
STANDARD NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY
MOTOR
KEY MUSCLES
R L
C2 C3 C4 C5 C6 C7 C8 T1 T2 T3 T4 T5 T6 T7 T8 T9 T10 T11 T12 L1 L2 L3 L4 L5 S1 S2 S3 S4-5
Elbow flexors
Wrist extensors
Elbow extensors
Finger flexors (distal phalanx of middle finger)
Finger abductors (little finger)
0 = total paralysis
1 = palpable or visible contraction
2 = active movement, gravity eliminated
3 = active movement, against gravity
4 = active movement, against some resistance
5 = active movement, against full resistance
NT = not testable
Hip flexors
Knee extensors
Ankle dorsiflexors
Long toe extensors
Ankle plantar flexors
Voluntary anal contraction (Yes/No)
TOTALS (MAXIMUM) (50) + (50) = (100) MOTOR SCORE
LIGHT TOUCH
PIN PRICK
R L
0 = absent
1 = impaired
2 = normal
NT = not testable
SENSORY
KEY SENSORY POINTS
Any anal sensation (Yes/No)
TOTALS (MAXIMUM) (56) (56) (56) (56)
PIN PRICK SCORE (max: 112)
LIGHT TOUCH SCORE (max: 112)
* Key Sensory Points
NEUROLOGICAL LEVEL
The most caudal segment with normal function
SENSORY
MOTOR
COMPLETE OR INCOMPLETE?
Incomplete = Any sensory or motor function in S4-S5
ASIA IMPAIRMENT SCALE
ZONE OF PARTIAL PRESERVATION
Caudal extent of partially innervated segments
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# Modified Rankin Scale (MRS)

0 No symptoms

1 No significant disability, despite symptoms; able to perform all usual duties and activities

2 Slight disability; unable to perform all previous activities but able to look after own affairs without assistance

3 Moderate disability; requires some help, but able to walk without assistance

4 Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance

5 Severe disability; bedridden, incontinent, and requires constant nursing care and attention

6 Death

Signature of Candidate

Signature of Supervisor

## INFORMED PATIENT CONSENT

Date: _____

I.....D/o, W/o, S/o..... am willing to participate in the study **"CLINICO-RADIOLOGICAL PROFILE OF SPINE INJURY AT DAYANAND MEDICAL COLLEGE AND HOSPITAL".** The procedure with its complications has been explained to me in local vernacular language. I have fully understood that no special tests and extra expenditure in any form, merely for the purpose of thesis is being carried out. I am free to opt out of the study any time without assigning any reason.

.....

.....

Signature of the Witness Signature of the patient

Name:

**Signature of Candidate** **Signature of Supervisor**

# मरीज अनुमति फार्म

तिथि _____

मैं _____ पत्नी/पुत्र/पुत्री _____
निवासी

_____ इस शोधकार्य "**CLINICO-RADIOLOGICAL PROFILE OF SPINE INJURY AT DAYANAND MEDICAL COLLEGE AND HOSPITAL**" में भाग लेने के लिए सहमत हूँ। मैं इस शोधकार्य में भाग लेने के लिए अपनी स्वेच्छा से तैयार हूँ। मैं पुष्टि करता/करती हूँ की यह स्वीकृति देने के लिए मुझे कोई आर्थिक प्रलोभन नहीं दिया गया और न ही दबाव डाला गया है। मुझे इस शोधकार्य का उद्देश्य स्पष्ट कर दिया गया है और मुझे यह विश्वास है की यह विज्ञान और मानवता के लाभ के लिए है। मुझे इस शोधकार्य में होने वाले जोखिम के बारे में समझा दिया गया है और मेरी समझ में यह जोखिम बहुत मामुली है।

मैं इस शोधकार्य में भाग लेने के सम्बन्ध में किसी भी समय अपनी अस्वीकृति व्यक्त कर सकता/सकती हूँ और मेरे अस्वीकृति व्यक्त करने का मेरे इलाज पर कोई प्रभाव नहीं पड़ेगा।

_____ _____

गवाह के हस्ताक्षर रोगी के हस्ताक्षर/अंगूठे का निशान

नाम: नाम:

_____

अन्वेषक के हस्ताक्षर

_____

विद्यार्थी के हस्ताक्षर

ਮਰੀਜ਼ ਰਜ਼ਾਮੰਦੀ ਫਾਰਮ

ਮਿਤੀ_____

ਮੈ_____ਪਤਨੀ/ਪੁੱਤਰ/ਪੁੱਤਰੀ_____
_____

ਵਾਸੀ

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**"CLINICO-RADIOLOGICAL PROFILE OF SPINE INJURY AT DAYANAND MEDICAL COLLEGE AND HOSPITAL"** ਤੇ ਚਲ ਰਹੀ ਖੋਜ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਰਜ਼ਾਮੰਦ ਹਾਂ। ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਲਈ ਮੈ ਆਪਣੀ ਮਰਜ਼ੀ ਨਾਲ ਤਿਆਰ ਹਾਂ। ਮੈ ਇਹ ਦਸਣਾ ਚਾਹੁੰਦਾ ਹਾਂ/ ਚਾਹੁੰਦੀ ਹਾਂ ਕੇ ਇਹ ਰਜ਼ਾਮੰਦੀ ਦੇਣ ਵਾਸਤੇ ਮੈਨੂ ਕਿਸੇ ਵੀ ਤਰਾਂ ਦਾ ਲੋਭ-ਲਾਲਚ ਨਹੀ ਦਿੱਤਾ ਗਿਆ ਅਤੇ ਨਾ ਹੀ ਕੋਈ ਦਬਾ ਪਾਇਆ ਗਿਆ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਦਾ ਮਨੋਰਥ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਭਰੋਸਾ ਦਵਾਇਆ ਗਿਆ ਹੈ ਕੇ ਇਹ ਖੋਜ ਵਿਗਿਆਨ ਅਤੇ ਮਾਨਵਤਾ ਦੀ ਭਲਾਈ ਲਈ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਵਿਚ ਹੋਣ ਵਾਲੇ ਖਤਰੇ ਬਾਰੇ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ ਅਤੇ ਮੈਨੂ ਇਹ ਯਕੀਨ ਹੈ ਕੇ ਇਹ ਖਤਰਾ ਬਹੁਤ ਮਾਮੂਲੀ ਹੈ। ਮੈਨੂ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਦਾ ਢੰਗ – ਤਰੀਕਾ ਸਮਝਾ ਦਿੱਤਾ ਗਿਆ ਹੈ।

ਮੈ ਇਸ ਖੋਜ ਕੰਮ ਵਿਚ ਹਿੱਸਾ ਲੈਣ ਬਾਰੇ ਆਪਣੀ ਰਜ਼ਾਮੰਦੀ ਕਿਸੇ ਵੀ ਸਮੇ ਵਾਪਸ ਲੈ ਸਕਦਾ ਹਾਂ/ ਸਕਦੀ ਹਾਂ ਅਤੇ ਮੇਰੀ ਰਜ਼ਾਮੰਦੀ ਵਾਪਸ ਲੈਣ ਦਾ ਮੇਰੇ ਇਲਾਜ ਤੇ ਕੋਈ ਅਸਰ ਨਹੀ ਹੋਵੇਗਾ।

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ਗਵਾਹ ਦੇ ਹਸਤਾਖਰ ਮਰੀਜ਼ ਦੇ ਹਸਤਾਖਰ

ਮਿਤੀ_____ ਮਿਤੀ_____

ਪਤਾ _____ ਪਤਾ

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ਨਿਰੀਖਕ ਦੇ ਹਸਤਾਖਰ

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ਸਿਖਿਆਰਥੀ ਦੇ ਹਸਤਾਖਰ